West Virginia University Libraries
3 0802 101950526 2

1851

Northwestern University
Dental School
Library

Gift of

Dr. Joseph B. Bilek

DO NOT CIRCULATE

LECTURES

ON

MATERIA MEDICA, THERAPEUTICS

AND

SPECIAL PATHOLOGY

BY

A. H. PECK, M. D., D. D. S.

NORTHWESTERN UNIVERSITY DENTAL SCHOOL

J. B. Bilek 924 Ashland av.

CHICAGO

3-0

Locked Case
RK701
P43
1901

CHICAGO
THE BLAKELY PRINTING COMPANY.
1901.

STATEMENT.

It was my intention to thoroughly revise for this volume all subject matter as previously printed. Much of it had passed direct from the stenographer to the printer, many grammatical errors and much false syntax was the result. I have been unable this winter to give the time necessary to revise the subject matter on abscess, hyperæmia, inflammation, suppuration, pathology of the dental pulp and of the peridental membrane.

Whatever errors occur in this part of the volume I trust will be graciously overlooked.

I want especially to thank the three gentlemen who prepared and read papers, and all those who participated in the discussions. These class exercises assisted materially in rendering the winter's work pleasurable as well as profitable.

Most sincerely,

A. H. P.

Digitized by the Internet Archive
in 2011 with funding from
LYRASIS Members and Sloan Foundation

http://www.archive.org/details/lecturesonmateri00peck

TABLE OF CONTENTS.

PAGE.

Introductory Lecture 1
Arsenic—Class Work 74
Astringents, Antiphlogistics, Diaphoretics, Sudorifics—Class Work. 83
Antipyretics, Analgesics, or Anodynes—Class Work........ 85
Abscess, Definition and Formation of........ 119
  Alveolar 154
  Blind, Diagnosis of 156
    Treatment of 158
  Burrowing of Pus........ 163
  Continued 170
  Concluded 181
Classification and Therapeutics of Essential Oils and Some Other Agents 21
Cocain—Class Work 79
Children's Teeth 283
Deciduous Teeth.
  Aching Pulps of........ 285
  Abscesses in 286
  Canal Fillings 287
Dental Pulp, Histology of 143
  Blood and Nerve Supply of........ 146
  Irritation of 148
  Hypertrophy of 195
  Suppuration of 198
  Pathology of 201
Devitalization of the Pulps of Teeth........ 31
  Continued 38
Escharotics, Styptics, Hæmostatics—Class Work........ 82
Emetics, Anti-Emetics, Cerebral Depressants, Deliriants, Cerebral Excitants, Narcotics, Hypnotics, Oil of Cloves, Beechwood Creosote—Class Work 95
Essential Oils and Some Other Agents—Their Antiseptic Value; also Their Irritating or Non-Irritating Properties........ 9
Fibrils of Tomes........ 145
Hyperemia, Classes of 121
  Swelling of 124
Irritants, Tonics, Stimulants—Class Work........ 87
Inflammation, Diagnosis, Causes and Treatment—Paper by Mr. Falloon 60
  Discussion 65

- Inflammation 125
  - Exudates of 127
  - Classic Signs of 129
  - Swelling of 131
- Local Arsenical Poisoning 42
- Local Anesthesia, Paper by Mr. E. E. Copple 48
  - Discussion 55
- Neuralgia, or Nerve Cries, Etiology of 274
- Opium—Class Work 76
- Pathology and Classification of Pulpless Teeth Without Regard to Abscessed Conditions 99
- Pathology, Chemistry and Therapeutics of Putrescent Pulps 108
- Pulpless Teeth.
  - Chemistry of 109
  - Therapeutics of 111
- Pyorrhea Alveolaris, so-called 211
  - Causes of 212
  - Principles of Treatment 218
- Peridental Membrane.
  - Histology of 221
  - Offices of 222
  - Arrangement of Fibers, etc 224
  - Cells of 226
  - Pathology of 228
  - Simple Gingivitis 228
  - Calcic Inflammation of 238
  - Phagedenic Pericementitis 252
- Pathology and Therapeutics of the Soft Tissues of the Mouth 263
- Quinine, Haematics, Restoratives, Anti-Periodics, Cathartics or Purgatives—Class Work 89
- Relative Toxicity of Cocain and Eucain 292
- Root Canal Filling 43
- Strychnine, Cassia, and Cinnamon—Class Work 92
- Saliva, Constituent Elements of 232
- Salivary Calculus, Constituent Elements of 235
  - Deposition of 236
  - Destructive Properties of 236
  - Treatment of 237
- Suppuration 131
  - Continued 136
  - Micro-Organisms of 140
  - Recapitulation 142
- Small Tortuous Canals 46

FIRST LECTURE.

Delivered before the Senior Class, Northwestern University Dental School, Session of 1900-1901.

BY

ADELBERT H. PECK, M. D., D. D. S.,

Professor of Special Pathology, Materia Medica and Therapeutics.

FIRST LECTURE.

What I have to say to you this morning is by way of an introduction to the winter's work.

In regard to text-books: I shall be pleased if each member of the class will purchase Potter's Materia Medica and Therapeutics; not the Compend, but the complete work —the larger book. I select this book for the reason that it contains everything that is necessary for you to know in regard to drugs. It gives their origin, their physical properties and characteristics, their therapeutic and physiological action, dosage and antidotal treatment, all in a very compact form, much more so than any other book I might recommend.

There are other books for extended reading and for special reference which are valuable, and you can provide yourselves with as many of them as you feel able. I assure you that you cannot get too many if you will only use them, for we cannot become too familiar with our subject. I regard our field as one of the most important in the entire college curriculum, in which statement I believe you will agree with me.

Wood's book on Therapeutics is recommended for extended reading; also Hare's work on the subject is an excellent one. The latter is not so exhaustive as Wood's.

In regard to Potter's Compend, it is a most excellent little book. Those of you who do not possess it may have access to it in the library (of which I shall speak a little further on), but I feel like insisting on your providing yourselves with Potter's larger book.

About using these books: It will avail you nothing if you purchase them and do not study them. That is not the way to do. You had better have one book on a subject and master that thoroughly, than to have half a dozen complete standard works and not make use of them. What we want to do is to familiarize ourselves with the contents of the few books we have.

This matter of study is one of the most important phases of our work. Form the habit of study at the very outset. I realize that in a class of dental students, or in a class of any other kind of students, it is not an easy matter for some to study, to apply their minds diligently to the work, for the reason that their minds have not been trained to study. Thus, a close continued application to your work becomes irksome, tiresome, and you are unable to get the best results. Let me urge this upon you, as I did upon the class of a year ago,—begin the habit of study at once; do not wait until to-morrow, but commence to-day. I presume the majority of you intend to go to your rooms for work to-night and have made no other plans. (Laughter.) Begin to-night. Take your book, and if you cannot study more than five to ten minutes, study that length of time, and if you cannot grasp a certain point at first, study it over and over again and keep at that one idea until it has been made your own. Then to-morrow you will be able to study fifteen or twenty minutes, and you will grasp the ideas more easily than you did the previous night, and so on. If you form this habit in the beginning you will in a short time be surprised how easily you are able to apply yourselves closely to your studies and how easily the ideas in your books are made your ideas. I trust you will form this habit of close, diligent application at the outset and keep it up all the way through the college course.

As regards your individual class work: I wish also to urge upon you the necessity of, and great value to be derived from quiz classes. I urged this as well as I could a year ago, and I repeat it here because I know it is of value. You can do nothing during your college work, not only in this department but in all other departments, that will benefit you more than to divide yourselves into classes of convenient size, say, fifteen, twenty or thirty students in each section, for the purpose of quiz work. I should be pleased indeed if we might have a thorough organization of the entire class in this respect. Those of you who find your company most congenial should form these classes and select a leader. Let the leader select a certain subject which you are to study and on which he will quiz you.

There will be plenty of room in the building this winter for the accommodation of this kind of class work. The room formerly occupied by Dr. Black, known as the "Dean's Room," will be fitted up for this purpose. This lecture room may, at times, be used for the same purpose, also the junior lecture room. There will be still another room on the third floor at the south end of the building, fitted up purposely for this kind of work. In a few days, or, possibly in two or three weeks, when I refer to this matter, I sincerely hope that I will find the class thoroughly organized.

In regard to requirements as to treatment cases this year—and I feel some little trepidation about broaching this subject: You will no doubt remember that a year ago there was no increase in the requirements of members of the Senior Class, but this year there is an increase made by the Faculty after due consideration and for the sole reason that it is expected to result in your individual good.

The total number of treatment cases required of each individual member of the Senior Class this year is twenty. The same variety of conditions—pathological conditions—will remain as a year ago.

At least one case of scaling; after-treatment not necessary.

At least one case of Phagedenic Pericementitis is required.

At least one case of Calcic Pericementitis, or inflammation of the soft parts about the root of a tooth, caused by the presence of calcareous deposits.

One case of devitalization and removal of pulp, including root-canal filling.

One case of dead pulp, including root-canal filling; that is, the treatment of a tooth, the pulp of which has formerly died.

One case of Apical Pericementitis; which means an inflammation of the soft parts in the Apical Space—the tissues surrounding the apex of the root—not including inflammation of the body of the peridental membrane, but simply confined to the apex.

It was only a year ago that the latter form of disease was separated from Pericementitis in general. There are so many cases of simple Apical Pericementitis that it was thought best to bring this idea out more clearly.

One case of Alveolar Abcess, including root-canal filling. It does not make any difference, as stated, whether it be acute, chronic, blind or fistulous, so long as there has been pus formation in connection with the tooth consequent to the death of the pulp, constituting a case of what is commonly referred to as Alveolar Abscess.

Our plan of work in the Infirmary will be different this year from last. None of these treatment cases will be required of you under my personal supervision as heretofore. The demonstrators will have charge of this work and will be required to keep a record of it. Someone will be appointed especially to oversee the work and have general charge of it.

It has been decided to require a "write-up," if I may use the expression, from each member of the class, of at least two of these treatment cases during the coming winter months. What I mean is this: I want in as concise and clear language as you are capable of using, a written statement regarding the diseased condition of the case; the condition of the parts involved in the pathological state; the cause; your treatment and the result of the treatment—a short, concise history of all the conditions connected with that individual case. I shall make no special requirements as to what these cases shall be this year, and you may make your own selections as regards diseased conditions.

One of these "write-ups" must be handed me not later than the first of February by each member of the class; the second one not later than the fifteenth of April.

Dr. Ralph W. Parker will be your quiz master, and will meet you at least once a week and oftener, if it can be so arranged, as was the case last winter. This work will be commenced as soon as possible.

Another thought I wish to impress upon your minds this morning is the necessity of thoroughly sterilizing your instruments in connection with your infirmary work. Those of you who have the lectures of last year will remember that I laid much stress upon this point, and it is one that must not be lightly passed by. You cannot be too careful in this particular. All sorts and conditions of humanity come to you with all forms of diseased conditions in the oral cavity, and it will be dangerous to neglect thorough sterilization of your instruments after having used them upon such individuals.

What will be the best means for doing this? There is no doubt that after the debris has been washed off as thoroughly as may be with soap and water and other means, there is no surer method than boiling the instruments, not only for a moment, but five or ten or fifteen minutes. This, perhaps, will be as effective a manner of destroying germs or such forms of micro-organisms as you will be likely to encounter, as any. I do not know whether arrangements will be made so that it will be convenient for you to boil your instruments or not, but we will try to make it so. If not, the use of some potent solution is the next best means.

A cheap potent drug which may be used for this purpose you will find in Resorcin in a 15 or 20 per cent solution. Instruments, having been thoroughly cleansed and deposited in this solution for five or ten minutes, you may feel reasonably assured are thoroughly sterilized.

Bichloride of Mercury, in the absence of albumin, perhaps, would be more potent, but one drawback to its use is its liability to tarnish the instruments and corrode them unless they are wiped and dried immediately after removal from the solution, and it is a more dangerous drug to use.

Lysol is a good drug for this purpose. One disadvantage with that is its odor, it being strongly like carbolic acid, and to some it is undesirable because of this.

For general sterilization of your instruments you will find Resorcin as clean, as cheap and as potent an agent as you can use. Remember, I do not say you must get Resorcin; I do not care so much what you use, so long as it is a potent agent and does not injure the instruments.

The water in which you dissolve the drug for this purpose should not be taken directly from the hydrant. It should be clean water; that is, free from germs; and it is of the utmost importance after you have sterilized your instruments that you dry them with clean towels or napkins before putting them away. It would not be a wise proceeding to go to the trouble of sterilizing instruments and then pick up an old dirty towel that has been lying on the floor of the infirmary and perhaps been trampled upon and full of debris, and wipe your instruments with it. You will no doubt consider this warning unnecessary, and it is so to the majority, but I have observed that very thing.

Another important matter I wish to bring to your minds is this: The necessity of sterilizing not only the instruments but also self. (Laughter.) It is just as necessary that we be neat, tidy and clean as it is to have the instruments in that condition. So please do not at any time during the coming winter months approach your patients unless you are as clean as may be. It should not be necessary to dwell on this point, though sometimes I feel that it is necessary, when in making my rounds of the Infirmary I observe some fingernails, for instance, and other things about the person. Remember, it is said somewhere, that as the twig is inclined so the tree will be bent, or words to that effect (Laughter), and as we form habits in the beginning of our work here we are more than likely to allow these habits to follow us through life. Well, I do not want to stand here and moralize—I know better than that—but I would impress upon your minds, if possible, the great necessity of care in connection with these little things. You do not realize what a difference it will make to one standing by and observing you at work.

The other day I was over here for a moment in the Infirmary, and I observed a student at the chair—I did not go near him and did not care to—(Laughter) with a chew of tobacco in his mouth, working over a patient. I shall not say who it was, but it is true that I saw that very thing. Please do not do that, any of you. It is your right to use tobacco if you think you must have it, and it does not matter to me how much of it you use, because that is your right, but when you come to taking up the Infirmary work, for the sake of your patients, yourselves and everybody about you, rid yourself of it and rinse your mouth (Great laughter and applause). Gum is not quite so bad, but I do not like to see anyone working over a patient and chewing gum.

In the matter of borrowing instruments and appliances from one another: It is a necessity at times to borrow, and then it is perfectly legitimate and right, but what I wish to impress upon your minds is this, that borrowers may well be classed in three divisions. These divisions seem to be made necessary by past experience in connection with college work.

The first division consists of those who borrow from honest motives because it is a necessity. They go to their neighbor and frankly ask for what they want, at the same time intending to return what they borrow as soon as they finish using it. This is all right and legitimate.

The second division of borrowers consists of those who are honest from the standpoint of necessity, and may have some desire to be honest in the matter of returning, but whose intentions of returning what they borrow are not any too well grounded. This kind of borrower is bad. (Laughter.) There are many who borrow this way and forget (?)—to make it as charitable as I can—to return what they borrow. I sincerely hope that none of these will develop in this class. There have been all sorts of troubles arising in the past on this account; so bear in mind always the desirability of returning what you borrow.

The third division of borrowers consists of those who are not at all honest in their asking—if they take the pains to ask—(Laughter) and who have no desire, expectation or intention of ever returning what they borrow, and what they secure without borrowing. Their only desire is to make appropriations to themselves. If they have no use for the article at present, they feel that it may prove useful some time in the future. (Laughter). I wish to impress upon your minds that because of the trouble that has arisen in the school in the past, on this account, it is the policy of the school to be as severe as possible with this class of individuals when detected. If anyone wishes to go through school in this way, accept his diploma and go out to pratice dentistry with such a burden upon his conscience, why that is for him to choose, but I sincerely hope and trust that nothing of this sort will come to the notice of the school during the coming winter months.

I presume I.am not the only member of the Faculty from whom you will hear on this point, but I wish to impress upon your minds that he who is found out, if there be any, will possibly be made to feel that "it were far better had a millstone been hanged about his neck and he cast into the sea rather than to have been born." (Great laughter and applause.)

Last, but by no means least, I wish to call your attention to our Library and Reading Room. This is one of the grandest additions to the school we have ever made. The Library at present is not full; many books are expected within the next few days, and within a week or two at the outside, there will be on the shelves all books necessary for reference in connection with the college curriculum. Not only books connected with our immediate work, but works on dentistry from time immemorial down to the present day.

There is seating capacity in the reading room for about eighty, and we hope to see the chairs filled with students who are hungering after knowledge. Those of you who cannot make it convenient to provide yourselves with all the books necessary for your school work can find them there, and you can get them for study at any time when not in use by someone else. In this department will be found Wood's work on Therapeutics; also Hare's; Potter's Materia Medica, and the Compend; the United States Pharmacopea, etc.; also several copies of my lectures of a year ago.

It is the common saying that dentists, as a profession, are not a reading class of people, and this is too true, I am sorry to say. I trust we shall be able to instill into the members of this class the desire to extend your reading, to apply your minds to this line of work. You should not be satisfied with only that which is told you by the teachers in the school, but should broaden your minds as much as possible by outside reading.

I trust what I have said this morning has made an impression upon your minds and that you will think over these matters and not forget them. (Applause.)

SECOND LECTURE.

The Essential Oils and Some Other Agents—Their Antiseptic Value; Also Their Irritating or Non-irritating Properties.

(Copyrighted.)

Very soon after assuming the duties of the chair of Materia Medica and Therapeutics in college work I became convinced that in our literature there was much loose statement in regard to the action of the drugs we employ in dentistry. Especially did this seem true in regard to the antiseptic powers of the various agents employed as antiseptics. Further, the therapeutic action of these agents has generally not been especially considered. It seems that iodoform is still used by many as an antiseptic, though it has long been known that it has not that power. Also, that the presence of albumin renders the ordinary solutions of bichloride of mercury inert as to antiseptic power, and prevents its effectiveness in treating suppurative surfaces, yet it is persistently used for this purpose. Also, the essential oils, some of which have been previously shown to possess antiseptic virtues, have seemed to be looked upon as a group of antiseptics, and, as it has seemed to me, are being used without reference to their relative merits as antiseptics, or to their therapeutic effects upon the tissues to which they are applied. For these reasons I have, in my teaching in this institution, made trial of these agents in our Bacteriological Laboratory, as to their effectiveness as antiseptics, and have also in various ways made trial of their effects upon the animal tissues in order that I might speak definitely of my own knowledge of these matters. In this lecture I will give briefly my observations upon a number of these agents.

To determine the antiseptic value of these agents the following experiments were conducted: Test tubes, each containing ten c. c. of sterilized mutton bouillon (which amount will hereafter be referred to as the *unit of culture media*), were used. The broth in these tubes was, for the most part, infected with saliva from various members of the class. In each set of plants made, a control tube was used, i. e., a tube in which the broth was infected with saliva, but into which no antiseptic agent was placed, simply to act as a control for the results of the remaining tubes, into which antiseptic agents were placed. In each instance the control tube presented a full development of bacteria, thus proving the accuracy of each set of plants. One drop of the essential oil was first used in the tubes. When one drop prevented development of bacteria, the quantity was gradually decreased in other plants, until the least amount that would prevent development was ascertained. To divide the drop I placed ten drops of alcohol in a small vial, and into this placed one drop of the oil; the alcohol dissolves the oil immediately. I then used in the culture tube such proportion of the drop of the essential oil desired—one drop of the solution representing one-tenth of the drop of oil. Those drugs that were found ineffective with one drop were increased in other plants until found effective, or were given up as unsuitable or worthless as antiseptics. The same dropper was used throughout. When using the same dropper it will be observed that a drop of alcohol is smaller in bulk than a drop of an essential oil. Because of this difference in the size of the drops, ten drops of alcohol and one drop of an essential oil forms, as nearly as it can be figured, a ten per cent solution. And one drop of this solution represents one-tenth of the drop of oil.

An antiseptic must be regarded as a poison to the vegetable cell, and many of them act also as poisons to the animal cell. I undertook this series of experiments for the determination of these differences of poisonous effects with the idea that in selecting antiseptics for use in practice we should have special regard to the effect of the agents upon the animal tissue to which they are applied. To determine the irritating or non-irritating properties of these oils an extensive course of experiments with them has been conducted in connection with sores artificially produced on guinea pigs, and also on my own person. To determine the effect of these agents when applied directly to soft tissue, the applications were made, in each instance, to my own person. And pardon me when I say that I believe I have come to positive conclusions regarding some of the agents along these lines.

OIL OF CASSIA.—We find that three-tenths of a drop is the smallest quantity that will prevent the development of bacteria in the "unit of culture media," and there being sixty-seven drops of oil of cassia in one c. c., this agent is effective as an antiseptic in 1 to 2,233 parts; that is to say, one whole drop of the oil of cassia would prevent development of bacteria in 2,233 drops of infected broth. This explanation will hold good in connection with each agent I have used.

As a test of the irritating properties of oil of cassia, a pellet of cotton was saturated with it and placed in a small rubber cup, to prevent evaporation. This was applied to the surface of the skin and held there by means of a piece of court plaster large enough to cover it over and stick tightly to the surface of the skin about the edges. This was retained in place for twenty-four hours, during which time the irritation to the soft parts was by no means a pleasant feature. At the end of this period a blister invariably forms; however, the inflammation in the tissues at this time is not very great. The blister will occupy an area from one-half to one-third greater than that to which the oil is directly applied, and will fill and refill with serum several times before any tendency to recovery is noticed. At the end of forty-eight hours the inflammation in the parts involved is intense and occupies an area four or five times as great as that to which the oil is directly applied. Numerous small independent blisters almost invariably form about the circumference of the inflamed area. This condition continues for several days, and while the inflammatory process is at its height the sore is one of the ugliest and most formidable in appearance it has ever been my privilege to look upon. These sores, also, are very slow in healing. It is with seeming regret on their part that the inflammation is permitted to subside, and the parts to return to a normal condition. While these sores are in every way just as bad as has been described, they are, however, fraught with no serious consequences.

To further test the irritating properties of this oil, a sore, in connection with which there was considerable inflammation, was produced on a guinea pig and treated for a number of days with the spray of cassia, by means of an atomizer. So long as this treatment was continued the parts could not recover, but, quite to the contrary, the inflammation was greatly increased. Suppuration was then produced by infecting the sore with pus microbes. This in turn was treated with the spray of cassia, with the result that the germs were destroyed and the pus formation caused to cease, thus proving quite conclusively that this agent is an excellent germicide when applied to suppurating surfaces, as well as a most potent antiseptic.

To my mind, it is clearly proven that while the antiseptic and germicidal properties of this oil are of the highest order, it is one of the most irritating, in its effects on soft tissue, of all the agents with which we have anything to do.

OIL OF CINNAMON OF CEYLON.—We find that three-tenths of a drop prevents development of bacteria in the "unit of culture media."

Oil of cinnamon of Ceylon, as you well know, is very much of the same nature as oil of cassia. However, in some respects there is a marked difference between them. It has been demonstrated that oil of cinnamon is not so irritating to soft tissues as oil of cassia. An application to soft tissue, in the same manner that cassia was applied, and left for twenty-four hours, caused considerable irritation and formation of blister. At the end of forty-eight hours the inflammation was severe; however, not so intense as that caused by cassia, and the area of tissue involved in the inflammatory process was not so great. Also, the blister that developed by the application of cinnamon was by no means as large as that from cassia, occupying the center of the inflamed area and spreading over tissue in extent equal only to that to which the agent was directly applied. The blister and inflammation are not so persistent as is the case with cassia, the former refilling with serum usually but two or three times, and the inflammation passing away quite readily.

A sore, attended with much inflammation, on a guinea pig, was treated with the spray of oil of cinnamon, with the result that it was further constantly irritated and thus prevented from healing. Suppuration was then produced in the sore, and again treated with the spray of this oil—the germs being destroyed and the pus formation ceasing. The action of cinnamon was not so vigorous as that of cassia.

A SYNTHETIC OIL OF CINNAMON, a sample of which I secured last spring from the first lot sent to this country (it being prepared in both France and Switzerland), proves to be as potent an antiseptic as the regular oil, three-tenths of a drop preventing development of bacteria in the "unit of culture media." It is, however, in its first effects, more irritating to soft tissue than the oil of cassia. An application was made to soft tissue, and at the end of fifteen hours a fully developed blister, in extent larger than the area of tissue to which the oil was applied, was the result. There was very little inflammation or discoloration of the tissues. The first effect of this oil on the soft tissue was so vigorous, very much tenderness and inflammation were confidently expected to follow. In this, however, I was disappointed. The blister continued to refill with serum several times, but actually no tenderness or inflammation worthy of mention developed in the surrounding parts. I cannot recommend it for use in the treatment of pulpless teeth.

BEECHWOOD CREOSOTE is the next agent, from point of potency, as an antiseptic; five-tenths of a drop prevented development of bacteria in the "unit of culture media."

This agent is non-irritating to soft tissue. An application remaining for a period of thirty-six hours produced no irritation. The surface of the skin was slightly discolored and also slightly burned or seared over, but not to an extent that caused the loss of any tissue. A sore on a guinea pig was treated with the spray of creosote with the result that the inflammation gradually subsided, and the sore healed with little delay.

Another sore in which suppuration was produced was treated in like manner, the germs being readily destroyed and the pus formation stopped. Continued treatment resulted in the gradual healing of the sore. Creosote has proven its right to stand among the first, from point of potency, as an antiseptic, and because it has been demonstrated that it is non-irritating to soft tissues, it is a good agent, and in some cases a very desirable one, for use in the treatment of pulpless teeth.

OIL OF CLOVES.—Six-tenths of a drop prevented development of bacteria in the "unit of culture media." Oil of cloves is absolutely non-irritating to soft tissue. An application to the surface of the skin for thirty-six hours left no more evidence of having been confined there than so much sterilized water would have done. No irritation, no discoloration.

Sores were produced on guinea pigs and treated with the spray of oil of cloves. The inflammation subsided more rapidly than when treated with any other agent, and the sores healed as rapidly as they could. A sore in which suppuration was produced by being infected with pus microbes was treated with the spray of this oil; the germs were destroyed and the formation of pus was stopped.

A sore on my arm, produced by an application of cassia, became infected and pus formed. This was washed thoroughly with a 1 to 1,000 solution of bichloride of mercury every night for several times, and dressed in turn with iodoform, nosophen and aristol, with no other result than an absolute failure to stop pus formation. One night, after having washed the sore thoroughly with the bichloride solution, I poured oil of cloves onto the raw tissue. There was only a very slight smarting for a few minutes, after which its action was that of a quieting, soothing agent. The application was held in position for twenty-four hours. It was then removed; no pus was present and the little granulations could be seen springing up all over the surface of the sore. It was immediately dressed with aristol and let alone for forty-eight hours, at the end of which time it was perfectly healed.

OIL OF BAY.—Seven-tenths of a drop prevented development of bacteria in the "unit of culture media." Oil of bay, to me, is a comparatively new agent, and I believe I am warranted in making the statement that it is a new agent to the vast majority of the dental profession. Two years ago, a gentleman spoke to me about this oil, and said he had been using it for some time in the treatment of pulpless teeth, and that, so far as his clinical experience went, had found it to be an agreeable and efficient agent. He stated that he had not observed any bad effects, by way of irritation of the soft parts. He requested that I test it, which I did, with the result above stated, which places it in the foremost ranks of the list of antiseptics.

I have made two applications of this oil to soft tissue, retaining each in contact for thirty-six hours, for the purpose of observing its effect, and no irritation resulted in either case.

A sore was produced on a guinea pig with an irritant which caused intense inflammation. This was treated with the spray of bay for several days, and the closest observation did not reveal any additional irritation, but, to the contrary, the inflammation gradually subsided. However, not so rapidly or willingly as when some other agents were used—as cloves. A sore in which suppuration was produced, on being treated with spray of bay, yielded very nicely, the germs being destroyed and the pus formation stopped.

OIL OF SASSAFRAS.—Seven-tenths of a drop prevented development of bacteria in the "unit of culture media." This oil, in contact with soft tissue for thirty-six hours, produced no evidence of irritation. It has proven to be a very potent antiseptic. I have treated sores, in which there was marked inflammation, with the spray of sassafras, and the result was much the same as with the last previous agents, the inflammation subsiding, the irritation passing away and the sore healing. It has not exhibited the ability to destroy germs and prevent pus formation to nearly the extent that the stronger agents have.

OIL OF PEPPERMINT.—Eight-tenths of a drop prevented development of bacteria in the "unit of culture media." An application of oil of peppermint to soft tissue continued for thirty-six hours produced no irritation, no discoloration of the skin, no inflammation, thus showing conclusively that this, also, is non-irritating to soft tissue. A sore in which considerable inflammation was present was treated with the spray of this oil, with the result that the inflammation readily yielded, the irritation subsided and the sore healed. Another sore in which suppuration was produced was treated in the same way, with the result that the germs were destroyed and the pus formation stopped, which proves that this agent is not only an antiseptic, but also destroys the germs and thus prevents pus formation.

DR. BLACK'S "1-2-3."—This is the next agent in point of potency. One and four-tenths of a drop prevented development in the "unit of culture media," showing this agent potent as an antiseptic in 1 to 454 parts. "1-2-3," as you well know, is a preparation given to the profession a number of years ago by Dr. Black, consisting—the mild solution, so-called, and this is the one used in these tests—of one part oil of cassia, two parts carbolic acid crystals and three parts gaultheria. Possibly some of you will wonder why "1-2-3" is in any way an efficient and desirable agent, consisting, as it does, of cassia, carbolic acid and gaultheria; carbolic acid being not a positive persistent antiseptic, but one whose restraining effects upon the development of bacteria are only transient; oil of gaultheria being absolutely worthless as an antiseptic, and the use of cassia being so thoroughly condemned because of its extremely irritating properties. Of course, this agent depends upon the cassia for its antiseptic properties. The gaultheria is used as a diluent to the cassia. The carbolic acid was used more especially because of its anesthetic properties on soft tissue. When these different agents are properly mixed to form "1-2-3" it is the opinion of Dr. Black that there is more or less of a chemical union between them, so that the individuality of each separate agent seems to be lost, and the result is the formation of a new agent, or one with different characteristics from those possessed by the three individual agents. At any rate, it is non-irritating to soft tissue. An application to soft tissue continued for thirty-six hours produced no irritation. There was only a slight searing and discoloration of the surface of the skin. Sores with much inflammation present were treated with the spray of "1-2-3," which did not produce further irritation. Its action was more like that of a neutral agent (so to speak), not irritating the sore, nor, on the other hand, imparting to any appreciable extent, a soothing, quieting influence, the inflammation subsiding just about as it would if left to itself with all irritating influences removed. A sore, in which suppuration was produced, was treated with the spray of this agent, with the result that the germs were destroyed and the pus formation ceased.

"1-2-3," as formed with the present cassia of commerce, is not so potent an antiseptic as that formed with cassia obtainable several years ago. This must be due to the fact above stated, that cassia is so adulterated at the present time. In fact, "1-2-3" is lessened in potency in almost direct proportion to the extent of the adulteration of the cassia.

"1-2-3," as shown by these experiments, is abundantly effective, but if cassia continues to be adulterated the time may come when it will not be.

CARBOLIC ACID, 95 PER CENT.—One and eight-tenths of a drop prevented development of bacteria in the "unit of culture media," showing this agent effective as an antiseptic in 1 to 338 parts. Carbolic acid is not a permanent, positive antiseptic. Its restraining power on the development of bacteria, in the majority of plants one makes, is only transient. One and eight-tenths of a drop prevented development for a period of three days, after which the bacteria developed in most instances. The restraining effect of this agent upon the development of bacteria seems to be almost in direct proportion to the quality of the agent used in the culture tube. The use of this agent in dentistry is so familiar I need not dwell on that point.

OIL OF MYRTOL.—One and nine-tenths of a drop were necessary to prevent development of bacteria in the "unit of culture media." An application of this agent to soft tissue for thirty-six hours produced decided irritation, and there was a strong tendency to the formation of blister. The surface of the skin was destroyed. The irritation and inflammation present continued for two or three days, gradually abating. A sore on a guinea pig, being treated with the spray of this oil, showed evidence of further irritation. So long as the treatment was continued the inflammation refused to subside. A suppurating sore, being treated in the same way, was benefited by a gradual destruction of the germs and cessation of pus formation.

OIL OF CAJUPUT.—Six drops are necessary to prevent development in the "unit of culture media." Cajuput is non-irritating to soft tissue. Applications of this oil to soft tissue, retained for thirty-six hours, produced no evidence of irritation; in fact, the discoloration of the skin was very slight and remained but a short time. A sore on a guinea pig, in which there was considerable inflammation, was treated with the spray of this oil, and no increase of the irritation was produced. Another sore in which suppuration was produced was treated in the same way, with the result that the germs were gradually destroyed, its action, however, not being positive, for if the treatment was discontinued for a day or two the pus formation continued as before.

EUCALYPTOL (Saunders' and Merck's).—Six drops each of these preparations are necessary to prevent development of bacteria in the "unit of culture media." Eucalyptol in contact with the skin for thirty-six hours produced no eviwas applied and for about two inches in all directions was turned as white as pure snow, as if all the blood were driven from the parts. The pain was lessened very considerably within a short time after the application was removed. The tissue to which it was directly applied was perfectly anesthetized to a considerable depth. Just at the circumference of the application there was much tenderness. There was much swelling, which seemed to be more like that of edema than of true inflammation. In about two or three days some color began to return to the parts, except to which the agent was directly applied, which latter never regained normal color. In about two days more a line, purple in color, began forming at the circumference of the point of application—a line of demarcation—and it became apparent that there was to be a break in the tissues. This break occurred and sloughing took place; considerable tissue was lost all over the surface of the inflamed area. The tissue in the center raised about the edges, but was very obstinate about coming away. From the time the agent was thoroughly absorbed in the tissues, physically, I was not up to the standard; my appetite was more or less impaired. the digestive and eliminative organs were somewhat interfered with. These conditions continued to grow worse until the climax came in quite a severe case of systematic poisoning, the poisonous matter being thrown off through the medium of quite a severe diarrhea and also much vomiting—the former continuing for a period of three days, the latter for one day, following which time my physical condition rapidly improved.

Having seen a number of cases which have been treated by physicians with various per cent solutions of formalin, in which more or less sloughing of the parts has resulted—one which I saw not long since in which as low as a 2 per cent solution was used, in connection with which considerable sloughing resulted—and also because of the very vivid recollections of my own personal experiences with it, I have come to the conclusion that we should get along without it in the treatment of diseased conditions about the mouth. (Applause.)

THIRD LECTURE.

Classification and Therapeutics of the Essential Oils and Some Other Agents.

(Copyrighted.)

It is probably true that in times past the vast majority of practitioners of the dental profession have made selections from the Essential Oils for purposes of treatment with only one idea in view, and that was the ability of the oil selected to successfully combat the pathological conditions only as regards the presence of micro-organisms and their poisonous products, never, in most instances, giving a thought to the probable action or therapy of the agents on the soft tissue with which they might come in contact.

It has evidently been the general impression that the Essential Oils represent a group of potent antiseptics, and that no mistake could be made, in this respect, if any one of them were selected for use, whereas, some of them possess no antiseptic virtues, and some, too, that have previously been thought by many to rank among the most potent of the oils, and the use of which has been strongly advocated. The therapeutic action of these agents on soft tissue has seemingly never engaged the attention of the majority of practitioners.

The many letters I have received from dentists in this and other countries, since the publication of my paper on "The Relative Value of These Agents as Antiseptics, and Their Irritating or Non-Irritating Properties," serve in a remarkable way to verify the above statements.

It is my purpose, in the work I have done in connection with these agents, to so classify them, both as regards their relative antiseptic value and their therapeutic action on soft tissue, that all may be able to select from them wisely and with certainty for the treatment, not only of the pathological conditions as regards the presence of micro-organisms and their poisonous products, but also as regards the various pathological processes in the surrounding soft parts.

It is of the utmost importance, if we hope for the best results in connection with our treatment cases, that we understand clearly the relative value of these agents as antiseptics, and also in what manner they affect soft tissue, whether there will result a further aggravation of the conditions by irritating the parts and thus continuing the inflammatory movement, or whether they will actually destroy the animal cells as escharotics do. Or, on the other hand, whether, in connection with the necessary action of antiseptics, they will assist in reducing the inflammatory movement, thus acting as sedatives—imparting a quieting, soothing effect.

There is no longer any necessity for a careless, unthoughtful selection of the oils adapted to the lesions that present for treatment, and he who continues to use a certain agent for a certain purpose only because someone has told him it is a good, reliable one to be thus used, not considering whether it be an *irritating* or a *non-irritating*—a *stimulating* or a *sedative* agent—only looking to its antiseptic powers, cannot hope to conduct this part of his practice with satisfaction either to himself or to his patients.

All antiseptics act as poisons to the vegetable cell, are poisons to micro-organisms, and many of them act as poisons to the animal cell. Sulphuric acid is an antiseptic, but who would ever entertain the proposition to use it in ordinary treatment cases? Its well-known destructive effects on the tissue forever preclude any possibility of its being used in this connection. The same might be said of arsenic and many other drugs of like nature. Oil of mustard, one of the Essential Oils, is an excellent antiseptic, but it is so powerfully irritating that no dentist ever thinks of using it in his practice.

It is now possible to definitely classify the Essential Oils as regards their action on soft tissue, and thus be able to select wisely from the list those, the action of which on the various diseased conditions of the soft parts is accurately known. I am pleased in this connection to present the following classification—first, *Irritating* or *Stimulating* antiseptics, chief among which are Oils of Cassia, Cinnamon and Myrtol.

Second, *Soothing, Quieting* or *Sedative* antiseptics; these are Oil of Cloves, Beechwood Creosote, Campho-Phenique, and Creosote and Iodine in solution.

The third class we shall designate as *Neutral* antiseptics or those that do not irritate the parts; neither do they impart a sedative action to inflamed tissue. These are the Oils of Bay, Sassafras, Peppermint, "1-2-3," Cajuput and Eucalyptol.

In the selection of these oils for various treatment cases it is just as important, that we may use them intelligently, to understand their action upon soft tissue, as it is to understand their power to destroy infectious material. It cannot be good practice to use an oil that will in a reasonable time effectually destroy the infectious properties of the contents of a pulp canal, and at the same time is so irritating to soft tissue that if confined in contact with it for from twelve to twenty-four hours will induce intense inflammation and result in the formation of a blister. Is it not equally important in connection with the treatment of a condition accompanied with inflammation, that an agent be selected that is not only a good antiseptic, but that will not further irritate the pathological conditions and continue the inflammatory movement? One should be selected that will act, in connection with its antiseptic power, as a sedative, reducing the inflammation, and thus assisting materially in removing the diseased condition and causing the parts to return to a normal state; or, at the very least, select one, the action of which, in connection with its antiseptic power, from the standpoint of an irritant, is *neutral*. Select one that will not irritate the tissues and thus continue the inflammatory movement, but that will permit the inflammation to subside as readily as possible after the micro-organisms, the exciting cause of the diseased condition, have been done away with through the antiseptic action of the medicinal agent.

If the antiseptic power of an oil is the only element to be considered, Oil of Cassia is without doubt the most potent, and hence the one for general use in treatment cases. It will destroy germs and will disinfect the putrescent contents of pulp canals equally well and in less time than will any other one of these oils. It is also probably more diffusible than are the others. The better samples of the present Cassia of commerce are potent as an antiseptic in 1 to 2,233 parts. Were it possible to secure Cassia unadulterated, it would show a potency of nearly, if not quite, twice that strength. It seems impossible at the present time to secure pure Cassia.

It is being largely adulterated with various agents; those most frequently used are the fixed oils, alcohol and kerosene oil. This adulteration of the Essential Oils is by no means confined to Cassia, for it seems the most of them are being more or less adulterated in like manner. Oil of Cassia has been placed in the first division—the class of *irritating, stimulating* antiseptics. It is because of its extreme irritating properties, always manifested when applied to soft tissue, that renders it unavailable for general use in treatment cases. When confined in contact with the skin of any portion of the body for from twelve to twenty-four hours, it will penetrate the epidermis, and so very poisonous is it to the animal cell that it incites a severe inflammatory movement and never fails to cause the formation of a blister. The fact that the soft parts about a tooth's root, in the canal of which Cassia is being used, become so highly inflamed, thus rendering the tooth painful to pressure, which condition can be due only to the poisonous action of the oil, makes it very clear that this agent should not be used generally in treating pulpless teeth. In fact, I feel warranted in making the statement that this oil should never be placed where it is to be confined any length of time in contact with soft tissue. If it will penetrate the epidermis and cause blister formation in the tender tissue underneath, who can doubt its similar action on the soft tissue in the apical space which has no epidermis to be penetrated? More than once have I observed a weeping of serum from the apical tissues into the pulp canal, in which Cassia had been used, and this, in my judgment, was nothing else than the discharge of actual blister; there is always a highly inflamed peridental membrane connected with such cases.

It would seem that it is unfortunate that so potent an antiseptic as Cassia should possess such irritating properties as it does, thus rendering it unsuitable for general use. But I do not know that it can be considered a misfortune. It is, perhaps, rather a wise condition of things, because there are conditions of the soft parts connected with the various diseases we have to treat that require just such irritating, stimulating properties as Cassia possesses—chronic abscesses especially, with fistulous openings, in which there is little or no cellular activity throughout the diseased tract; the use of milder antiseptics, and those the action of which on soft tissue is neutral, fail to accomplish the desired result. Whereas the use of strong Cassia water, or in extreme cases the oil in full strength, results most beneficially. It excites that cellular activity throughout the parts that is necessary to effect a cure. In pyorrhea pockets, in extreme cases, Cassia in full strength, or in milder cases, diluted to suit, is one of the very best agents that can be used. It does not remain, in a concentrated form, in contact with the soft parts a sufficient length of time to cause undesirable effects, but long enough so the effects of its stimulating properties are imparted to the tissues.

In any diseased condition of the soft parts where the combined effect of a potent antiseptic and stimulant are indicated—cases in which the application of the agent to the part can be controlled—Oil of Cassia in this dual role is one of the most effective of the Essential Oils.

In this class, the agent next in value to Cassia as an antiseptic and a stimulant is Oil of Cinnamon of Ceylon. This oil is an antiseptic in 1 to 2,100 parts, very nearly as potent as the best samples of Cassia now obtainable. It is also very irritating and stimulating to soft tissues. If confined in contact with tissue for twenty-four hours, or even less, it seldom fails to produce a blister. The blister, however, is not so large as that caused by Cassia, and does not persist for so long a time, and the inflammatory movement is not quite so severe as is that produced by Cassia. In all cases where the use of these agents is indicated, they may be used interchangeably with nearly equally good results.

The third agent properly belonging to this class—Oil of Myrtol—is a much milder one as to antiseptic power, and also as to *irritating* or *stimulating* properties. It is an antiseptic in 1 to 357 parts. Myrtol is too irritating for general use. But in cases of diseased tissue in the apical spaces, perhaps following the existence of blind abscess, in which the cellular action is dormant, Oil of Myrtol when sealed in the pulp canal for a few days often results in much benefit. It is just stimulating enough to the soft parts to excite that cellular activity which is necessary to effect a cure. In any pathological condition of the soft parts where positive stimulation is indicated, and in which this effect is best imparted by sealing an agent to remain for a few days, Myrtol is unquestionably the best of the Essential Oils. We know it will not further complicate the conditions by greatly overstimulating the parts when confined in contact with them.

In the *Sedative* class of these antiseptics, Beechwood Creosote is the most potent as to antiseptic power, but as to *sedative, soothing* action on the soft parts, Oil of Cloves is, perhaps, the most valuable of the agents in this class. This oil is antiseptic in 1 to 1,150 parts. This is the result of tests made with the best specimens of the oil obtainable. Other samples which had been very much adulterated were tested, and, as was expected, in most cases exhibited an antiseptic power much inferior to that above stated. Some will occasionally complain that Cloves, when sealed in a pulp canal, cause irritation to the soft tissues in the apical space. I have been able to produce this result with this oil in connection with my experimental work. But whenever irritation has manifested itself from the use of Cloves, it has always been in cases where the poorer samples of the oil were used, those that had been largely adulterated; and the irritation that followed was the result of the action of the materials used for adulterating purposes, and was not, in my judgment, the result of the Cloves.

In purchasing Essential Oils for use, the time has come when one must look carefully to their quality and accept none but the best obtainable. I have now in my office a sample of Oil of Cloves, from one pound of which, by adulteration, I am reliably informed four pounds are produced for commercial purposes.

The only action of this oil, aside from its antiseptic power on diseased, inflamed tissue, is that of a local sedative—a quieting, soothing effect.

I once had experience with a terrific sore of the soft parts, accompanied with intense inflammation, this sore having been produced by an application of formalin. The muscles all about were drawn up and were rigid. The slightest movement of the parts was attended with extreme pain. The use of ordinary remedies seemed to afford no relief. One day in my desperation, after having thoroughly cleansed the parts with a bichloride solution, I poured pure Oil of Cloves into the sore; there was only a slight smarting for a minute, and immediately after the sedative effect of the oil was plainly manifested; there was a soothing sensation produced throughout the parts; the disagreeable drawn condition of the muscles began to pass away; their rigidity was being overcome, and within a few hours' time the diseased parts could be moved about as freely as when in a healthy, normal state. There was also more or less local anesthesia produced in the tissues. It has long been known to many that by injecting a small quantity of Oil of Cassia into the central focus of the suppurative process of a boil further pus formation would cease, and it has also been known that, in each instance where it was so used, it greatly intensified the inflammatory conditions. It is now known that Oil of Cloves thus injected into these suppurative processes will just as effectually stop the pus formation, and instead of intensifying or even aggravating the inflammatory conditions, it assists most materially in reducing them. In all cases of apical pericementitis, the therapeutic action of this oil is very beneficial. Its decided sedative properties render it one of the most valuable of these oils in the treatment of all inflamed conditions. Its most excellent antiseptic properties in connection with its sedative action place it as one of the most valuable of the Essential Oils in the treatment of all conditions of putrescent pulps and diseased parts, except those cases in the treatment of which a stimulating agent is indicated.

Beechwood Creosote is the next agent to be considered. This agent is antiseptic in 1 to 1,280 parts. It evidently possesses sedative properties to a sufficient extent to be classed in this division, for in the treatment of inflamed sores with the spray of this agent, this action is distinctly noticeable. I have also seen highly beneficial results produced in peridental inflammations, especially apical, when treated with this agent. It is especially useful in the treatment of cases of putrescent pulps of long standing, those in which the tooth's structure has become completely saturated with mephitic gases, odors, etc., for, of the available agents of this list, Creosote is unquestionably the most penetrating and persistent in its effects. For the treatment of cases in which much odor is present, this agent, relatively, is of special value, as it probably possesses the properties of deodorants generally to a greater extent than any other of these agents.

I have treated some cases with Creosote in which discoloration occurred, and have at times thought the discoloration was directly due to the action of the agent. This is a thought that it is well to keep in mind.

Beechwood Creosote and Iodine in solution properly belong in the division of sedatives. In many cases of inflamed peridental membranes—sore teeth, as they are referred to—this solution is an excellent one. I have never used it extensively because of its great discoloring propensities. However, in the posterior teeth, and in the roots of teeth that are to be crowned, where it does not matter so much if discoloration does occur, I can see no legitimate objection to the use of this agent. Its special value in such cases, as cited above, cannot be disputed.

This solution is also especially useful in cases of gingival pericementitis. When used for this purpose the gums should be well dried and the remedy applied with a piece of wood, whittled thin and narrow, so the agent may be pressed between the free margin of the gums and the neck of the tooth. Any excess of the agent should be carefully removed.

The next agent in this division is Campho-Phenique, and the preparation I have experimented with is composed of equal parts of gum camphor and carbolic acid crystals, and is antiseptic in 1 to 473 parts.

This agent belongs to the division of sedatives. Previous to this winter I had never used it as a dressing in root-canals of teeth, but had used it extensively for inflammations of the mucous membranes of the mouth. Also in connection with lacerated or otherwise injured gum tissue. Its soothing, healing properties have always produced the best of results. I have found it to be of special value in allaying the pain occasioned by the excess of cement which is forced out about the margins of the gums in setting crowns and bridges.

For some time I have used it extensively in the treatment of pulpless teeth with the best of satisfaction. It is especially valuable in cases of apical pericementitis, where the action of a sedative is indicated. This action, in connection with its excellent antiseptic properties, renders it a very useful and oftentimes a desirable agent for the treatment of all ordinary conditions of pulpless teeth.

The next division or class of antiseptics is the *non-stimulating* and *non-sedative*, or those the action of which on the soft parts in these respects is neutral. These, in their respective order from point of potency, are the Oils of Bay, Sassafras, Peppermint, "1-2-3," Cajuput and Eucalyptol.

The Oil of Bay is antiseptic in 1 to 1,028 parts, and is a comparatively new acquisition in connection with the practice of dentistry. It is without doubt a valuable addition to our list of antiseptics. In connection with the treatment of all conditions of pulpless teeth, where no other action on the part of the agent is indicated than that of a potent antiseptic, this oil in my practice has proven to be a valuable one. It may be confined in the pulp canals as long as it retains any virtue without evidence of irritation resulting. In the treatment of abscesses I have seen especially good results, particularly in cases of blind abscess.

The Oil of Sassafras is antiseptic in 1 to 1,000 parts, and the Oil of Peppermint in 1 to 875 parts. I have used neither of these oils to any extent in my practice. They are both good antiseptics, and do not irritate soft tissue, neither do they indicate any of the properties of sedative agents in the treatment of inflamed tissue, and I see no reason why they should not be valuable in general treatment cases. The odor of Peppermint is strong and penetrating, this being the main reason why I do not use it. I have used both of them, however, in an experimental way, sufficient to be able to state that they are efficient and do not cause irritation of the soft parts.

Dr. Black's "1-2-3" mixture has always proven itself a most efficient agent in the treatment of pulpless teeth, and has been used by very many in the profession for the last ten or twelve years, possibly more than any other agent. I have used it continuously since I have been in practice, and have never observed any bad effects from its use; no tenderness of the tooth to pressure, no irritation of the soft parts resulting.

There are no conditions of diseases about the teeth, except those in which the special action of a *stimulant* or a *sedative* is indicated, in which it would not be proper to use

"1-2-3." In its action it is one of the most reliable and positive of all these agents.

Oil of Cajuput is one of the least potent of the effective agents. It is antiseptic in 1 to 120 parts. This, however, is sufficiently potent for ordinary purposes, and it is in no wise irritating to soft tissue. My use of it in connection with pulpless teeth has been limited; in fact, I have seldom used it except occasionally to moisten the inner walls of pulp canals previous to filling them with gutta-percha, as it is a good solvent of that material.

Eucalyptol, which is produced by a redistillation of the Oil of Eucalyptus, also belongs to the milder class of these agents. It is antiseptic in 1 to 116 parts. For general treatment purposes I have used Eucalyptol but very little. It is in no wise irritating to the soft parts, and is the agent I have, in the past, most frequently used to seal in the canals for a few days previous to filling, after having removed devitalized pulps. For the purpose of slightly moistening the inner walls of the canals previous to filling them with gutta-percha, Eucalyptol is the agent I nearly always use. It dissolves the surface of the gutta-percha, causing it to adhere more firmly to the walls of the dentin.

PROF. PECK'S FOURTH LECTURE.

Devitalization of the Pulps of Teeth.

The first question that naturally presents under this subject is, "when to devitalize," or what cases are necessary to be devitalized, and I wish that I could dismiss the question with the bare statement that pulps should be devitalized whenever it is necessary to do so, but, of course, I cannot do that; the conditions vary so much that it is frequently quite a problem to decide wisely, correctly, whether it is best to devitalize the pulp of a tooth or whether it is best to try to save it. In a general way I may state the following instances in which it seems necessary to devitalize: In all cases where the roots of teeth are to support bridges, or are to be crowned, the pulps should be devitalized, even though the teeth may be sound, or nearly so, and briefly, for these reasons: It is always necessary to do so much cutting to properly shape the natural crowns for the artificial ones that it is almost impossible, in the majority of cases, to do so without causing intense pain to the patient; another reason is, that often in doing this some horn of the pulp is nearly exposed and thus subjected to the irritating effects of the cement and to those of thermal changes, thus giving rise to a slow form of irritation, which continues and becomes greater, until finally inflammation sets in and the pulp dies. Another reason, and one which, in my judgment, cannot be overlooked, is the fact that nearly all cements, the phosphates, contain more or less arsenic. This has been proven conclusively, although some claim that the amount of arsenic contained in the powder is so small that it cannot cause trouble, but I have seen numerous cases where I am satisfied that trouble has resulted from this source. It is my judgment that in setting crowns with oxyphosphate of zinc, where the teeth are extensively cut, there is danger of causing devitalization. But the chief reason is the one first mentioned, in my judgment, why the pulps should be devitalized when the teeth are to be used for this purpose, because it is so difficult to properly prepare them for the band without causing such intense pain to the patient and encroaching so near to the pulp that the latter is left exposed to future irritating influences.

A second class of cases in which it is nearly always necessary to devitalize previous to filling or other operations is those in which the pulps have been exposed to the irritating effects of saliva, micro-organisms and other substances in the mouth by the process of caries. There is not one such case in a thousand, in my judgment, that will survive a very great length of time under a capping.

Another class of cases in which the pulps should be devitalized is those in which pulps are accidentally exposed as a result of careless manipulation of burrs, and occasionally hand instruments, the pulp tissue being punctured or lacerated to a considerable extent so that more or less hemorrhage occurs. It does not matter what the condition of the patient, whether young and healthy, or aged and infirm, in the great majority of cases the pulps will die under capping.

A fourth class is those in which pulp nodules have formed. This is one of the most difficult pathological conditions to accurately diagnose with which we have anything to do.

It may be stated in a general way that the chances for saving pulps in the teeth of persons living in malarial districts, other things being equal, are much less than in more healthy localities. If there is any doubt as to whether it is best to try to save pulps for such individuals the safest procedure is to devitalize.

Condition of Pulps for Devitalization.

When it is necessary to sacrifice a pulp, a very important question is, in what condition should a pulp be before proceeding to devitalize, by whatever means. If a pulp is inflamed it is not in a good condition for devitalizing. It should be placed in as nearly a normal healthy condition as possible. Why is this necessary? Why is it not as well to apply paste or other means of devitalizing when the pulp is inflamed, as it is when it is in a healthy condition? It is a fact that inflamed tissue, in whatever portion of the body, resents the action of medicinal agents. If the tissue is inflamed the blood vessels are engorged with blood, the surrounding connective tissue is invaded by the products of inflammation; that tissue will stubbornly resist the absorption of medicinal agents. In the treatment of inflamed pulps, which latter are confined within the bony walls of a pulp-chamber, thus rendering expansion of the tissue impossible, there is necessity for more care than in the treatment of inflamed tissue in any other portion of the system. If paste or other means for devitalizing is applied to an inflamed pulp the action of that pulp is to resist the absorption of the agent and the result is a further disturbance of the organ, which causes greater pain to the patient. If inflamed tissue could absorb medicines as readily as when in a normal condition then the proper procedure would be to apply devitalizing agents and remove the pulp as soon as possible.

Palliative Treatment.

Palliative treatment should be resorted to in cases of inflamed pulp, in the majority of instances, before attempting to devitalize. What may we use to reduce the inflammation of a pulp? By way of medicinal agents the following are as useful as any: Oil of cloves, applied warm; oil of cloves and carbolic acid 95 per cent, or the crystals melted, equal parts; oil of cloves and sulphate of morphia, mixed to a thin paste; sulphate of morphia and hydrochlorate of cocaine, equal parts, thoroughly mixed, oil of cloves added in sufficient quantity to form a thin paste; wine of opium, applied warm, is excellent, and in some instances pure beechwood creosote is good.

Where palliative treatment is to be used the decayed dentine and debris in general should be removed as thoroughly as possible. The pulp should be exposed, or as nearly so as may be, so that the agent will have free access to the inflamed tissue. Then agents should be applied with absorbent cotton, or other similar means, in a way to avoid pressure on the pulp. Seal tightly, either with gutta-percha stopping or cement, and leave for a day or two, as the case may be. It will occasionally be necessary to repeat the application before the inflammation will materially subside. The most positive way to reduce the congested condition of a pulp is to lacerate the tissue and let the excess of blood escape. Sometimes this can be successfully done and with little inconvenience to the patient.

Method of Devitalizing.

There are a number of different methods for devitalizing pulps advocated and practiced at the present time. Arsenic, which has for years been the principal agent used, is now largely replaced, by many operators, with other means. The dangers attending the use of arsenic and the extreme care necessary to avoid poisoning adjacent tissue have ever caused the profession to be anxious to welcome any efficient means unattended with such dangers. This is evidenced by the favor accorded various methods that have been presented from time to time. Not many years ago the use of a small orange-wood stick was advocated and practiced by many. In the anterior teeth especially, which afford direct access to the root-canal. The pulp being exposed, the stick was dipped in carbolic acid and placed in contact with the pulp, and by a sharp blow with the mallet was driven into the pulp-canal half or two-thirds the distance to the apex. On withdrawing the stick it was claimed the pulp would always come away with it. Not a few were enthusiastic in their advocacy of this method. I have seen it used in a few instances with apparently no inconvenience to the patient, and again I have seen it used where it seemed almost barbarous. I cannot recommend this method.

Another means for devitalizing, and one that has been practiced during the past few years to a great extent, is that called cataphoresis—the use of electricity with cocaine in solution. I will say for this method that it is an excellent one in many instances, and in the hands of a competent operator, the preparatory work for its use having been thoroughly and rightly done, is a process by which pulps may be successfully removed in many cases within a few minutes' time. I have used this method a great deal since its recent revival with good results in most cases. I feel warranted in making the statement that the street current should never be employed in cataphoresis. There are certain dangers connected with the use of this form of electricity. The storage battery, or what, in my judgment, is still better, the dry-cell battery, should be used.

In the use of this method it is necessary that the field of operation be protected by the use of the rubber dam and other means, whenever necessary, to prevent saliva from flowing in about the gingivæ of the tooth, also to prevent the current from passing out in contact with the soft tissues. When operating in connection with compound proximate cavities in bicuspids and molars it is well to build an artificial wall from the cervical portion of the cavity to the occlusal surface with oxyphosphate cement. Allow the cement to flow over the cervical margin slightly onto the rubber dam between the teeth so that the cavity is positively protected from the ingress of moisture. Then a pellet of cotton saturated with a cocaine solution is placed in the cavity over the pulp. The positive pole of the instrument is applied to the cotton in the cavity, while the negative pole is applied to some other portion of the body, usually one of the hands, so as to complete the circuit of the current in the system. Then the current is gradually turned on, which causes the drug to penetrate the parts being operated upon, thus anæsthetizing them. Objections to this method have been raised by many because of the time necessarily consumed in its application. Frequently it is necessary to take anywhere from fifteen to forty-five minutes to produce results. However, in connection with favorable cases, pulps have been anæsthetized and successfully removed within five minutes from the time of application of the current.

Another method is the use of cocaine in solution under pressure. To successfully use this method the pulp should be exposed and in as nearly a normal condition as possible. I have found an aqueous solution of the drug to be as satisfactory as any. Some advocate the use of cocaine dissolved in alcohol and various other medicaments added, but in my practice I have failed to observe any special benefit from any of these. A pellet of cotton is saturated with the agent and passed into the cavity; then a piece of vulcanite rubber large enough to a little more than fill the cavity is placed over the cotton. Firm pressure should then be applied by means of an instrument, which is nearly as large as the cavity itself. Care should be taken that this pressure is applied directly over the pulp, and it is necessary that it be carefully applied at first so as to avoid unnecessary pain to the patient. As soon as the patient does not manifest pain from the pressure, the pulp, in a majority of cases, can be removed without inconvenience. I have found this means quite useful in destroying the sensitiveness remaining in portions of the pulp approaching the apices of the roots. Frequently in attempting to devitalize, especially with other means, a portion of the pulp at the end of the root remains and not infrequently develops severe sensitiveness, which is difficult to control. The use of arsenic is undesirable because of the close proximity of the tissue to the foraminal opening.

The use of arsenic for devitalizing purposes is, and has been, the standard means employed by the profession for years. Arsenous acid, white arsenic, with a chemical symbol of As_2, O_4, is the form of arsenic used. This drug is best used in combination with other medicinal agents to form a paste. The following formula is, in my judgment, as good as any:

Arsenous acid	grs. xx.
Hydrochlorate cocaine crystals	grs. v.
Sulphate of morphia	grs. v.
Oil of cloves	m. iij.

Glycerine sufficient to make a stiff paste.

The addition of five per cent of lampblack will be found an advantage. It colors the paste and makes it easier to detect any particle that may have gotten outside of the cavity onto the tooth or the rubber dam. The lampblack does not in any way interfere with the efficacy of the paste.

Previous to the application of arsenical paste it is necessary that all decayed dentine and other debris that may be present be thoroughly removed from the cavity. All frail margins of the cavity should be cut away, and whenever possible a positive exposure of the pulp should be effected, so that the paste may be applied directly to the pulp tissue. To insure best results, the pulp should be free from inflammation, or as nearly so as possible. A quantity of paste half the size of the head of an ordinary pin is all that is necessary to be used. This should be applied on a small pellet of cotton or a small piece of writing paper, as stated, directly in contact with the pulp. In thus applying the paste, pressure upon the pulp tissue should be avoided.

In devitalizing pulps, especially in bicuspids and molars, where it is difficult to place the temporary stopping without imparting pressure upon the pulp, it is well to place immediately over the arsenical application an oval-shaped disc of metal, such as tagger's tin or thin German silver, over which the temporary stopping may be placed without danger of exerting pressure upon the pulp. The cavity should be carefully sealed with oxyphosphate cement or with some variety of gutta-percha stopping. In the hands of an operator who is expert in the use of gutta-percha, it is my judgment that cavities can be more securely sealed with this material than with cement. In the use of whatever material for this purpose the margins of the cavity must be thoroughly dried, so that the material will adhere as closely as possible to them, thus preventing the ingress of moisture or the egress of the arsenic. After the cavity has been sealed, and before removing the rubber dam, as a precautionary measure to prevent poisoning of the soft tissues in case any of the arsenic has passed outside of the cavity, dialyzed iron should be freely used about the tooth. This agent, in sufficient quantity, renders arsenic inert. Dialyzed iron should thus be used rather freely, as it requires from four to five volumes of this agent to destroy the potency of one volume of arsenic.

In dealing with disto-occlusal cavities in bicuspids and molars it is frequently an advantage to build an artificial wall from the cervical portion of the cavity to the occlusal surface of the tooth, previous to the application of the arsenic, as indicated in the use of cataphoresis. This will reduce to a minimum the possibility of any arsenic being forced out of the cavity when placing the temporary stopping.

In teeth of adults, arsenical applications should remain at least forty-eight hours, and in many cases may remain even longer without causing any trouble. In the permanent teeth of young people arsenic should not, as a rule, remain more than twenty-four hours. The devitalization of pulps in the teeth of children is considered in a separate lecture.

PROF. PECK'S FIFTH LECTURE.

On removing the arsenical application, if the pulp tissue is not sensitive, it may be removed at once. If the tissue is still sensitive, and in the majority of cases it will be, glycerite of tannin may be sealed in contact with the pulp and left for five to seven days. This will absorb the moisture and cause the fibers of the tissue to become toughened. The lapse of time permits the remaining sensitiveness to subside so the tissue can be removed without inconvenience to the patient.

A 20 per cent solution of tannic acid in glycerine, with 5 per cent of alcohol added, should be used. The alcohol thins the solution and adds to its antiseptic value.

Tannic acid is somewhat irritating to soft tissue and in some cases may cause slight apical pericementitis. I believe in the majority of cases this untoward result is not manifested to an extent as to render the use of this agent undesirable. In some cases, instead of using glycerite of tannin, I have used a mild, non-irritating antiseptic, pending the subsidence of the sensitiveness, with very good results.

After the pulp has been removed, the pulp chamber and cavity thoroughly cleansed with peroxide of hydrogen, whether it be at the first sitting or a subsequent one, a mild, non-irritating antiseptic should be placed in the root-canal by means of a thread of cotton. This should remain for five to seven days, as the case may seem to require, previous to filling. It is not well, as a general rule, to resort to immediate root-canal filling. Devitalization and removal of pulps, even under the most favorable conditions, leaves the tissues involved at the end of the root in a wounded condition. Sufficient time should elapse between the removal of pulps and the insertion of root-canal fillings for the lacerated tissues to heal thoroughly. If this is not done, apical pericementitis in an aggravated form is likely to follow as a result of irritation of the wounded tissues by the pressure of the filling material.

Treatment should not be left in the root-canals too long a time. Overtreatment is as undesirable as insufficient treatment.

If for any reason the medicines are left too long a time, trouble frequently follows. The agents are slowly, gradually, continually absorbed by the soft tissues, which latter become more or less impaired. At first the tissue shows signs of irritation; this induces an excessive flow of blood to the part; the blood accumulates and the small veins become affected and are unable to carry that blood away as fast as it comes; it accumulates and becomes venous in character, and after the lapse of weeks, or perhaps months, the cotton is removed and considerable hemorrhage follows. This not infrequently gives rise to some speculation as to the cause of the flow of blood.

I will read a letter which I recently received from a practicing dentist which will further elucidate this particular point. He says: "I take the liberty of asking for a little information in regard to a troublesome tooth under my care. Some time ago I devitalized the pulp of one of Dr. ——'s teeth, who, by the way, is a dentist himself; first lower molar, using arsenous acid, which was removed in two days. Then I placed tannic acid and glycerine and let it remain two weeks. At the expiration of that time the pulp was removed without pain or hemorrhage. I cleansed the canals with pyrozone and sealed with oil of cloves. A period of six weeks has elapsed since I saw the patient, but in the meantime it has been treated by another dentist as I have been away from my office. The treatment was only in for a short time when the tooth became so sore that he had to remove the treatment. I used pyrozone. There was no odor, everything looked fine and I used oil of cloves in the root-canals and sealed, leaving a vent in the temporary filling. In forty-eight hours the tooth became sore, elongated and the face slightly swollen. I removed the temporary filling and the root-canal dressing and this was followed by a severe hemorrhage. The tooth, of course, felt easier at once. Now, where I am in trouble is, what shall I use for root-canal dressing and what was the cause of so much blood when I had been particular not to pass the broach through the apex of the root?"

The difficulty in connection with this case is just what

I have outlined above. The treatment was in the canals so long that the tissues in the apical space became diseased, became irritated, became hyperæmic, first actively, then passively; finally inflammation set in in a mild form and caused the tooth to become tender to pressure, resulting in pain, and when the treatment was removed the excess of blood flowed from the apical space and the patient experienced instant relief. It was not the use of the antiseptic that caused the trouble; it was its misuse, by leaving it in too long a time. Of course there would not be any odor, gas or anything of that nature because the trouble had not progressed far enough, had not been infected with germs, which is necessary that such conditions may result. The parts involved were aseptic, yet inflammation was present. As soon as the hemorrhage and other abnormal conditions are well under control the root-canals of such cases should be filled. If infection has not taken place the conditions of irritation will, as a rule, gradually pass away. An opening should be made through the gums and the alveolar plate of bone into the apical space of those cases which continue to cause trouble. The diseased tissues should be thoroughly removed from the apical space and the case treated aseptically until the parts heal.

There is one other condition it is well to consider in this connection, and that is, it is rarely ever advisable to undertake to devitalize the pulps in teeth the former of which are already dead! It may seem superfluous to make mention of this, but the mistake is occasionally made, and it is under certain conditions an easy one to make.

The pulp of a tooth has died; the tissues have become infected; the tissues in the apical space have become irritated and inflamed; the membrane about the root is more or less inflamed so that pain is caused by the slightest pressure upon the tooth. If these conditions are not closely observed when adjusting the rubber dam and performing other preliminary steps of the work, it is indeed not difficult to mistake the pain from the peridental membrane, caused by the pressure of instruments in removing the debris, for the pain of sensitive dentin. The patient manifests unmistakable evidence of pain with every thrust of the instrument, and it is taken for granted that the pulp is alive and necessary to be devitalized. All decay is removed that can be reasonably well under the conditions, and paste applied. The patient returns and the inflammation and tenderness have not subsided, possibly have increased, but after an application of paste it is necessary to effect an opening into the pulp chamber. Through persistence the opening is effected and the pulp is found to be dead. The debris is removed and the subsequent treatment made. The trouble in this is here. In applying arsenic to such a case it is not taken up by the pulp tissue because the pulp is already dead, but rather it is absorbed by the structure of the tooth; it penetrates laterally and in all directions throughout the dentinal tubuli in the crown of the tooth; the dentin thus becomes more or less saturated with it. The treatment is completed and the root-canal and cavity are filled. The case rests possibly for some months with no indication of trouble, but finally the arsenic penetrates the structure of the tooth and is absorbed by the soft tissues of the gingivæ. These parts become irritated and perhaps inflamed; the tooth becomes tender to pressure and in some instances exceedingly so.

Heat and cold when applied affect the parts as thermal changes do hyperæmic or inflamed pulps, inducing pain more or less severe. These manifestations have been a source of much wonder and not a little irritation to the practitioner. There being no manifest apical pericementitis or inflammation of the body of this membrane, and the tooth being pulpless, why such manifestations should develop has not been plain. The gums will be more or less swollen and everted. Their color shows them to be not infrequently highly inflamed and usually they are denuded of their epithelium at the margins and bleed with the slightest provocation.

There is no specific form of treatment for this condition. The most necessary element is time that the pathologic manifestations may wear away. By way of medication, the parts should be frequently bathed with dialyzed iron. This drug seems to be more beneficial than does the use of ordinary sedative antiseptics. It may be found necessary to treat such cases in this manner for a number of weeks before the inflammation subsides. One case which I especially have in mind was treated for two months, two or three times each week, before the inflammation passed away. Hence, I repeat the caution in the use of arsenic, that in all cases where it is possible the pulp should be positively exposed that the drug may be applied directly to it and thus prevent, so far as possible, its absorption by the dentin.

Cases Not Affected by Arsenic.

There are some cases in which arsenic does not seem to affect the pulps. The latter do not absorb it to any appreciable extent. Even after several applications have been made directly to the soft tissue, a positive exposure being present, the pulp is as sensitive, and if any difference, more so than at first. No doubt in the majority of such cases, if the truth were known, the individual is a habitual user of the drug. Tolerance by the system of large quantities of poisons, such as arsenic, morphia and cocaine, is established in individuals by beginning with the internal use of small quantities and gradually increasing the amount. In such cases the circulatory medium and the tissues of the body in general are charged with the individual poison. This in a sense acts as an antidote to the effects of arsenic as the drug is used for devitalizing purposes. The extent to which these drugs are used internally by many individuals, especially in the large cities, is certainly surprising.

One encounters difficulty in devitalizing pulps of teeth for such individuals, not only with the use of arsenic, but also with any of the ordinary methods for devitalizing. In aggravated cases of this character there is no objection, in my judgment, to the administration of a systemic anæsthetic, such as nitrous oxide gas, and an immediate removal of the pulp. Indeed, in many cases this is the only satisfactory method that can be practiced.

Local Arsenical Poisoning.

To what extent arsenic will penetrate the soft parts is something of a question. Some claim it is self-limiting in its action, i. e., it will penetrate the tissues just so far. Others claim it is not self-limiting. My judgment is, and this is borne out by clinical observation, that the extent to which the drug will penetrate the parts depends on the quantity present. A small amount will cause but slight destruction of tissue, while a larger amount will cause more extensive destruction of the parts involved.

The affected tissues will be much inflamed, swollen and of dark color. Pain, constant in many cases, is present. The teeth involved are loose because of the inflamed, swollen condition of the peridental membrane. These manifestations will vary in degree according to the extent of the poisoning. In cases where one is certain a considerable quantity of arsenic has come in contact with the tissues and that the destruction of the parts will thereby be extensive, it is good practice to anticipate the extent to which the drug will be absorbed by immediately resorting to minor surgery and cutting the tissues out. The wound receiving proper aseptic treatment will readily heal.

Cases in which the manifestations are fully developed should be treated locally with dialyzed iron and sedative antiseptics for the purpose of controlling the inflammation and pain as much as possible. In severe cases involving the peridental membrane quite extensive necrosis of the alveolus will result. Such cases must be treated palliatively, treated as indicated above until the sequestra exfoliate.

What has thus far been said regarding the use of arsenic for devitalizing purposes has reference especially to the teeth of adults. In dealing with the teeth of children the arsenic should not be confined in the cavity so long a time. In the permanent teeth of patients from twelve to fifteen years of age I believe the drug should not be confined in the teeth longer than twenty-four hours. As to the deciduous teeth, the use of devitalizing agents will be considered under the general head of *Care of Children's Teeth.*

Root Canal Filling.

There are a number of methods of root-canal filling advocated and practiced. Some consider one method the best and others consider another method the best. Among the various materials used may be mentioned the following:

Oxychloride of zinc is advocated by some as the best material to be used. They claim that the antiseptic property of chloride of zinc is penetrating and lasting, and for this reason consider this material one of the best. However, the fact that oxychloride of zinc disintegrates and wastes in the mouth, in my judgment renders it an undesirable material for root-canal filling.

Some advocate the use of wood points. They saturate them with beechwood creosote or carbolic acid or dip them in chloro-percha and press them into the canals.

Others advocate the use of fine metallic points, copper being the metal usually used. Either of these methods, in my judgment, are absolutely useless and should never be used.

Gold foil, No. 3 or 4, is used by some. Cutting a narrow strip of the foil it is wrapped tightly about a smooth broach and then loosened so that it may be readily passed into the canal. This is dipped in some thin oxyphosphate or oxychloride of zinc, as the case may be, and packed into the root-canal. In the canals of anterior teeth, which are of fair size and the roots straight, gold foil may be used to good advantage and a good root-canal filling may be made with it. I do not think, however, that the use of either form of cement is desirable for the reason that cement might be forced in the foraminal opening ahead of the gold, in which case the cement would probably be disintegrated, thus leaving an opening for the accumulation of moisture and germs which would degenerate and cause trouble in the future. I would not ordinarily recommend the use of gold foil for filling root-canals.

In cases where the apices of the roots are to be excised, if gold foil can be successfully used for filling the canals previous to that operation, I believe it is better, for the reason that in removing the end of the root the filling material is less likely to be disturbed than is gutta-percha.

In this operation it is necessary that no defect be left in the canal filling at the point of excision.

I believe that the physical qualities or characteristics of gutta-percha render it more nearly an ideal material with which to fill root-canals than any other we have. It is essential that whatever material is used shall be non-irritating to soft tissue, or as nearly so as possible. Also that the material shall be indestructible, i. e., so far as wasting by the process of absorption or by action of any of the fluids of the system. Another important quality is perfect and easy adaptation. The material should be one that is easily adapted to all the irregularities that exist along the root-canal. The material, when in proper condition for use, must be soft and pliable.

It is my judgment that these various qualities necessary to constitute an ideal root-canal filling are found in gutta-percha. This material is, perhaps, of all substances that may be used for this purpose, the least irritating to soft tissue. It is not absorbed or wasted to any extent by the fluids with which it may come in contact. However, it is not absolutely impervious to moisture. A sheet of gutta-percha placed in a basin of water for a time will take up more or less of the liquid. However, I believe it the least undesirable in this respect of any of the materials that might be generally used in practice.

Gutta-percha should be used in the following manner: First, when the canal is ready to be filled, i. e., is aseptic and thoroughly dried, the inner walls of the canal should be slightly moistened with eucalyptol. This is best accomplished by the use of a thread of cotton wound tightly on a smooth broach which will readily pass to the end of the root. An excess of eucalyptol should not be used; just enough to slightly moisten the walls of the canal. This serves to further dissolve the chloro-percha, which is to follow, and aids in causing it to penetrate the lateral openings along the canal, if there are any, and also causes it to adhere more firmly to the walls of the canal. Then a small quantity of chloro-percha or gutta-percha, dissolved in chloroform, should be passed into the canal. This also is best done by the use of cotton wound tightly on a broach. An excess of chloro-percha must not be used, only enough to form a thin layer along the walls of the canal. In no instance should canals be filled with this solution, except in the very fine canals where it is impossible to place a gutta-percha cone. A cone of gutta-percha which is small enough to pass readily into the canal should now be used. This may be passed with the pliers and should be pressed into the canal as far as possible and permitted to remain for a minute or two, when the small end of the cone will be softened by the chloro-percha. With a few blasts of hot air from the syringe the large end of the cone, or that projecting from the canal, may be thoroughly softened. Then with a root-canal plugger that will pass readily into the canal the softened gutta-percha should be carefully but thoroughly packed. If this material is used in this manner it will constitute a perfectly adapted and resistant filling.

Small Tortuous Canals.

Not infrequently the canals in the anterior roots of lower molars, and less frequently perhaps in the buccal roots of upper molars, are so fine and tortuous that it is impossible to satisfactorily open them. However, every effort should be made to gain access to these canals. It is as much a part of one's duty to exhaust every legitimate means to effect an opening in these cases as it is to see that all root-canals of convenient size are properly cleansed and filled. Very fine canals, if they are not tortuous, may frequently be enlarged. When the canals are tortuous in their course it is much more difficult to satisfactorily enlarge them. I believe the drills or burrs in the engine should never be used in an endeavor to open such canals; the danger of cutting through the tooth structure into the peridental membrane is too great. Not infrequently such canals can be effectually and rather speedily enlarged with barbed steel broaches. A fine one that will enter the canal a short distance should be used first. These broaches, when used for this purpose, should be regarded as cutting instruments. They should be passed into the canal as far as may be at first and pressed laterally against the walls and withdrawn, the barbs serving to cut the tissue. This process may be repeated, pressing the broach farther down the canal and withdrawing in this way until the canal is satisfactorily enlarged. The use of a fine broach may be followed with a coarser one, thus enlarging the canal to the extent desired. I believe this a more satisfactory method than the use of hand drills or burrs with flexible shanks.

The use of sulphuric acid has been advocated and practiced by many within the past few years for the purpose of enlarging canals, and I believe a careful, conservative use of this agent for this purpose in many cases to be good practice. I have many times used it with gratifying results. When sulphuric acid is used for this purpose I believe a

50 per cent solution is sufficiently strong. The acid is best passed to the entrance of the canal by means of a fine platinum broach. An excess of acid must not be used. This is worked into the canal as far as may be and allowed to remain for a few minutes. It dissolves the organic material in the dentin, thus leaving the removal of the inorganic material a relatively easy matter. Before using the instruments for the purpose of removing the softened tooth structure, the dentin to which the acid has been applied should be thoroughly bathed with an alkaline solution. This is done for the purpose of neutralizing the acid present. Then a barbed broach may be used for the purpose of removing the structure acted upon by the acid with little danger of the broach being corroded. The application of the acid may be repeated as many times as necessary to effect an opening to the end of the root. The alkaline solution must be used after each application. In no case should the acid be permitted to pass through the foramen in contact with the soft tissues in the apical space.

It will be found impossible in some instances to gain access to some of these canals even with the finest broach. They have become obliterated to that extent and are so tortuous in their course that a satisfactory opening cannot be effected. With such cases as these one can only do the best he can, and that is to treat with proper antiseptics, allow them to be disseminated throughout the canal, if there be any, as much as possible, and in filling depend entirely upon chloro-percha. It is my judgment that canals of this character will rarely ever cause trouble.

PROF. PECK'S SIXTH LECTURE.

Mr. E. C. Copple read a paper entitled, "Local Anæsthesia," which was as follows:

Anæsthesia is a condition of insensibility or loss of feeling. Anæsthetics are agents which produce or bring about this condition. They are divided into two classes—general anæsthetics and local anæsthetics. General anæsthetics are agents capable of producing complete insensibility throughout the entire system. Local anæsthetics are agents whose action is limited to a certain part or organ, and which, when topically applied, temporarily destroy or diminish sensibility. It shall be the purpose of this paper to note a few points of possible interest in regard to the latter division.

Local anæsthesia is employed in one way or another by most practitioners of medicine and dentistry throughout the country. In the surgical operations which a dentist is called upon to perform he finds in the local anæsthetic a most valuable agent. Its use will add to the comfort of the patient and to the convenience of the operator. The application of an anæsthetic to the gums about the roots of teeth which are being prepared for the reception of crowns, or in the setting of crowns or bridges, has been found beneficial. The placing of the dam or clamps, ligatures, cervical clamps or the opening of alveolar abscesses, are often very painful to the patient. I have seen a local application make any of these operations easily and satisfactorily performed. Another use of local anæsthesia with which you are familiar is the removal of pulps of teeth. That, however, for which the dentist most often desires the use of something to relieve pain, and that for which the patient most often requests its use, is the extraction of teeth.

Local anæsthesia may be produced by a large variety of drugs and by other means, ranging from the harmless numbing of the nerve filaments with ice to the use of some very dangerous mixtures or compounds of cocaine. Dr. Craig divides the methods of producing local anæsthesia into three classes: (1) Those which act upon the nerve filaments by producing cold or numbness, (2) the infiltration method, (3) those acting by the inherent characteristic or strength of the drug itself, applied locally or injected. We shall endeavor to follow this classification.

Under the first division, those producing anæsthesia by reducing the circulation and numbing the nerve filaments with cold, may be mentioned the use of ice two parts and salt one part, applied locally. This, however, if allowed to remain long enough, will freeze the immediate part, which often does occur. This, of course, is undesirable and results in the breaking down of tissue. Sterilized ice water may be used by injection, though in this way its action is partly by infiltration.

A spray of sulphuric ether on the mucous membrane lowers the temperature. This was at one time the best local anæsthetic in vogue, but it is not now used. It was employed for extraction of teeth by local application upon the gums, a special apparatus being used. If the tooth had a live pulp the sensation of cold was very disagreeable, and also sloughing of the gums very often followed. This is always undesirable. Sulphuric ether was replaced by what is known as rigolene, obtained by the distillation of petroleum. It was an improvement.

Both of these have now been entirely replaced by a much more reliable and convenient agent, chloride of ethyl, $C_4 H_5 Cl$. This was discovered by Dutch chemists in 1795, but was not employed as an anæsthetic until 1851, when Dr. Snow of England first used it for this purpose. It is a gas at ordinary temperature, but under pressure becomes a colorless liquid. It burns with a greenish flame, boils at 12 degrees C., has an aromatic taste, is very volatile and inflammable and must be kept in hermetically sealed glass tubes. It is comparatively dangerous when inhaled and is practically used only for a local anæsthetic, being applied in the form of a spray. It produces a rapid lowering of the temperature of the skin and a complete anæsthesia of the region touched and its adjacent parts. It is put up in glass tubes with a screw cap made of metal. In the end of the tube is a small opening, through which the ethyl chloride is forced when the tube is opened and the temperature is raised by holding the tube in the hand. The temperature of the hand is quite sufficient to force the liquid out. A very small stream or spray, kept playing upon the skin or mucous membrane, will in from four to six seconds, or longer, produce a white spot, which indicates that the part is ready for operation. Before making the application of chloride of ethyl, the surface of the part to which it is to be applied should be thoroughly sterilized and then covered with glycerine, vaseline or collodion. Especially should this be done if the tissues are inflamed or delicate. This will avoid the direct irritation caused by the drug. The most serious objection to the use of all powerful refrigerative agents is that if they be continued a little too long sloughing is very likely to follow.

The replacing of the normal fluids of the tissues by a fluid of greater specific gavity, such as water, is known as the infiltration method of producing local anæsthesia. It causes anæmia, compression, a lowering of the temperature and temporary paralysis of the nerve filaments. The fluid is injected into the subcutaneous tissue and fills the lymph spaces and small vessels of the part, thus depriving the nerves of their normal supply of blood. Cold sterilized water is often used for this purpose, but perhaps a much better agent is a physiological salt solution. This is simply a one-sixth of one per cent solution of sodium chloride in water.

The third class of local anæsthetics includes all those medicines or drugs which, when injected or applied locally, produce the desired result by virtue of their intrinsic strength. As to the definite action of the drug in producing its effect, there is a difference of opinion. Some authors claim that the action is that of immediate paralysis of the sensory nerves, while others claim that the action is a vaso-motor one, thus depriving the tissues of blood and destroying the power of the nerve filaments to transmit sensation.

A mixture known as A. C. E., consisting of alcohol 1 part, chloroform 2 parts, ether 3 parts, is an agent belonging to this class, to produce anæsthesia. It is applied topically to the surface to be anæsthetized and held in position one-half to two minutes, when anæsthesia sufficient for small operations is obtained. An ingenious apparatus for using this method in the extraction of teeth was arranged by Dr. Von Bonhorst. It consisted of small metal cups containing pieces of sponge. These cups were fastened to the ends of a spring bent in the shape of a hairpin. The sponges were saturated with the solution and placed one on each side of the process opposite the tooth to be extracted. The cups hold the anæsthetic in place and also prevent evaporation. Rubber cups such as we all have in our cases will answer the purpose fully as well as the metal ones and cotton will be just as good as the sponge.

The passage of the drug into the tissues may be much accelerated by a current of electricity. Cataphoresis for the production of local anæsthesia has been given much time in experimentation and has been used by many leading dentists. It was used to considerable extent in the removal of pulps from teeth, minor operations about the mouth and in the extraction of teeth. For the latter purpose the positive pole is supplied with a sponge electrode, which is saturated with a two per cent solution of cocaine. The mucous membrane may be pricked with needles to assist in the passage of the liquid into the mucous membrane. To this surface the positive pole with the sponge electrode is applied. The negative pole is held in the hand of the patient, or, as is sometimes done, applied to the mucous membrane on the opposite side of the tooth. The continuous current in the tissue from the positive to the negative electrodes carries with it the liquid and the substance in solution. In this way the cocaine is carried into the tissues about the tooth. This method is used very little if at all at present. There is difficulty in obtaining complete anæsthesia about the roots of teeth, and there is also a great tendency toward the breaking down of tissue under the positive electrode.

In connection with electricity I might here mention another method of its use in extraction. It does not come within any of the three divisions of local anæsthetics. It consists in attaching the positive pole to the forceps. The negative pole is held in the patient's hand. When the forceps come in contact with the tooth the current is established. The strength of the current was depended upon to paralyze the nerves about the root of a tooth. Such a result was not always secured. The method is not now used.

The method most generally in use for producing local anæsthesia is the employment of the hypodermic needle. This consists in the introduction of medicines into the tissues with a syringe. Practitioners everywhere use it many times oftener than any other method. Success depends more upon the drug used for injection than upon any one other thing, though having a good instrument, familiarity with its use, a knowledge of the parts operated upon, and absolute cleanliness are essential points for consideration. Some operators prefer a syringe with a glass barrel so that the contents of the syringe can be plainly seen; others want the piston graduated so that the exact quantity of fluid injected may be calculated. These are important facts to consider in connection with an instrument of this kind. Others gauge the quantity injected by the appearance of the tissue and prefer an all-metal syringe, which combines strength of the instrument with ease of sterilization.

The danger from sepsis in the use of the hypodermic syringe is of utmost importance. Too much emphasis cannot be put upon this point. The instrument should be thoroughly sterilized after each operation. The transmission of disease from one patient to another, or the injection of micro-organisms which may have lodged on the needle and remain there through carelessness on the part of the operator, is inevitable unless great precaution be taken. To sterilize the syringe it should be boiled for several minutes, or it should remain half an hour in a five per cent solution of carbolic acid, or it should be sterilized by use of some of the modern methods of sterilization of instruments. The liquid or solution to be injected should be frequently boiled to insure sterility. Tablets prepared by manufacturing chemists are presumably aseptic, but they do not remain so if carelessly handled. It might be well to state here that boiling destroys the anæsthetic properties of cocaine, so that when it is used the drug should be added to the already sterilized water. Another source of sepsis would be the surface of the mucous membrane, through which the injection is to be made. This should be thoroughly dried and sterilized before operating.

Another point to be noted before inserting the needle is the exclusion of air from the syringe. This is accomplished by holding the instrument with the needle upward and pressing on the piston until the liquid oozes out.

If it is desired to use an anæsthetic in the way of an injection of any liquid or solution for the extraction of teeth, care should be exercised in the manipulation of the instrument. The needle should be inserted not far from the gum margin about the tooth to be extracted, and never more than half way up the alveolar process. The needle must pass through the epithelium and deposit the liquid in the submucous areolar tissue. Enough fluid must be injected to whiten the mucosa in the immediate neighborhood of the puncture and cause a slight elevation, and no more. Both buccal and lingual injections should be made, though some operators make only lingual insertions of the needle.

The tissue of the dental area, especially those surrounding the teeth, are very vascular and are more or less loose and spongy in nature. The epithelium is of the stratified squamous variety and the outer layers are tough and horny. The connective tissue beneath this, however, is more or less loose and well supplied with blood and lymph vessels. The bony process is spongy and vascular. The blood vessels supplying the region anastomose freely. Small vessels of the peridental membrane not only connect with those of the subepithelial tissues by passing over the edge of the process, but branches from the peridental membrane pass directly through the process to the submucous tissue. In this way all the tissues about the roots of the teeth are closely connected by a system of blood vessels. Any liquid injected into the subcutaneous tissue about a tooth readily enters the lymph spaces and small blood vessels and is soon carried to all parts of the adjoining area, thus filling all the tissues about the tooth with the anæsthetizing agent. It is very important that the injection be not made at the line of junction of the alveolar and buccal mucous membranes. Along this line the needle enters very loose tissue, in which too great a quantity of the solution must be injected in order to have the required effect upon the desired point. It is too far from the field of operation.

Extraction should be done as soon as the patient himself can notice the anæsthesia. This will be usually from forty to sixty seconds. After the extraction the excess of the solution may sometimes be removed or expelled by puncturing the swelling and applying digital pressure upon the gum.

Among the preparations used for injection may be mentioned sterilized water, methyl, Bracine phenol and others, all of which have been used with various results. Antipyrine is used extensively as a local anæsthetic. It is strongly recommended by many and some report only favorable results from its use. Cocaine solutions are also used.

On account of the widespread tendency among practicing dentists to use cocaine solutions for extraction of teeth, it might be well to repeat here a few of the effects of that drug. Patients come into the office and ask for, and even demand, the use of an anæsthetic for extraction. You are too familiar with the effects of cocaine upon the system and the danger connected with its use for me to take time for an extensive discussion of that. The great danger from the use of the drug is its unreliability as to the systemic effect. There is no certainty as to the result of its administration to any patient.

The disastrous local results from the use of the drug are sometimes very severe. The sloughing of the tissues, accompanied by severe pain, is a frequent occurrence. Also the loss of deeper tissues often follows, and even the approximating teeth, with portions of the process, have been known to come away. This, however, is not due directly to any inherent characteristic of the cocaine itself, but to a condition known as ischemia. Ischemia is a deficiency in the supply of blood to a part. It is local anæmia. This may occur as the result of the injection of other fluids than the solution of cocaine. For a time after the injection the part remains without its normal supply of blood, and when the circulation is restored the tissue cells may be beyond the point of resuscitation. If such be the case, the only result that can follow is the loss of tissue.

Many proprietary combinations of cocaine for use hypodermically are now on the market. Some have many good qualities, others have very few. However, that agent whose anæsthetic properties are perfect and whose use is entirely safe and harmless, remains yet to be discovered. If we had such an agent other methods of producing local anæsthesia for extractions would soon become obsolete.

Dr. Peck: I am pleased to state that six gentlemen have promised to discuss this paper, and, I presume, are prepared to do so. With six who have especially looked up the subject, with a view of discussing it, insures an interesting discussion, and I am pleased to call first upon Mr. Thomas.

W. A. Thomas: I might as well at the very beginning make the excuse that I forgot to look up the subject, as to offer the few remarks that I have to say.

I did have the privilege of looking over Mr. Copple's paper and found that he had so thoroughly taken up the subject there was little left that one could talk about.

We all, after listening to Mr. Copple's paper, can say with Dr. Peck that it is an excellently written one, and shows careful thought and study. I enjoyed it all very much, but more in particular what was said in connection with the hypodermic syringe, especially as it is what we will all have to make more or less use of when we get out into practice.

In this connection I might say that it is the practice of some, after the surface has been sterilized, to make an application of campho-phenique.

This anæsthetizes the part so that the needle can be inserted with little or no pain. Digital pressure is also sometimes used for the same purpose. We might add to the list of local anæsthetics already mentioned, odentunder and Wilson's solution.

Dr. Peck: The next gentleman is Mr. Ireland.

Mr. Ireland: I will make a few remarks further on cocaine. Cocaine is a delicate subject; indeed, it seems so much so that our professors will not demonstrate its use in the infirmary, but when they wish to demonstrate the use of this drug it is always on dogs or guinea pigs. This is enough in itself to make us very cautious in its use. But when we leave school and go into private practice we will find that our brother practitioners almost invariably rely upon cocaine for the purpose of local anæsthesia. Especially will we find this so in the smaller places, where nitrous oxide cannot readily be obtained. The question naturally arises, what are we to do to retain our patients? We must extract teeth without pain, as the patient says the dentist across the street does. When I arrived home last summer a dentist there asked me what preparation of cocaine the faculty advised in the extraction of teeth. I told him they advised nothing but the use of the forceps. He asked me, and I answered in the affirmative, whereupon he told me that I might as well quit dentistry at once. This gentleman enjoyed a lucrative practice, and I have known people to go from fifteen to twenty miles to have a single tooth extracted. I was setting a bridge last summer which I constructed for my sister and the pain became so severe that she begged for cocaine. I at last gave in and made a saturated solution and applied it by means of cotton to the soft parts around the root of the tooth. The application was continued for about fifty seconds, when the bridge was set without any further pain. But in about twenty minutes the patient complained of her voice sounding very far off. A few minutes later she was taken with a severe headache. I examined her pulse and found it to be very irregular; it would be very strong for a while and then there would be an intermission of several beats. This was in the country about one mile from the village. I made a quick trip to see the local druggist, not knowing exactly what I was going for. While I was on my road thinking over the drugs that Dr. Peck had recommended for the antidotal treatment of cocaine, it occurred to me that opium was the only one that I knew anything about, and the only way I knew of administering this was in the form of Dover's powders. I secured some Dover's powders and also a bottle of brandy. (Laughter.) When I arrived home I found my sister in bed complaining of general numbness. I again examined the pulse and found it very alarming. I administered a fifteen-grain dose of Dover's powders and half a glass of brandy. This may have been a crude way of administering the drug, but it did the work, and within thirty minutes the patient was asleep. She never gave in that it was cocaine that caused the trouble, and said if the operation was to be performed again she wanted cocaine. If we are going to use cocaine, I think it wise that we provide ourselves with all the restoratives first, and then I think we would make a serious mistake if we forgot to add cocaine to our list.

Dr. Peck: Had the patient been Mr. Ireland instead of his sister, and he insisted on having cocaine the second time, I would think that the reason was that he was certain the brandy would follow. (Laughter.) The next gentleman who has consented to discuss the subject is Mr. Hull.

Mr. Hull: I think that most of us who have had anything to say on this subject must have read about the same books in the library. There are only a few, and what we looked up was mostly in those. I noticed that Mr. Copple omitted one little point, and that was the obtunding of sensitive dentine—I believe that would come under the head of local anæsthesia—and in the book that I read it only gave the process of cataphoresis, as the dentine is so hard that it won't absorb any of the milder forms of anæsthetics, and it needs the current of electricity in cataphoresis to force the drug into the dentine. Some have spoken of the use of carbolic acid in cavities. I don't know what the general effect is or how well it is liked, but I never could have much, if any, success with it, and I think it is due to the fact that there is nothing there to force the carbolic acid into the dentine. Another point was the injecting of fluids around inflamed areas. We all know that an inflamed area refuses to absorb the fluids like normal tissue. The process given was to insert the needle three or four times around the inflamed area, starting at some distance back and making the insertions closer to the area and finally inserting the needle into the inflamed area itself. That was more for surgical operations, I believe, than dental, because it spoke of beginning the operation in the subcutaneous tissue. I notice Mr. Thomas spoke of one solution called Wilson's Solution. I had some occasion to use that this summer, and I used up one bottle. It seemed to work all right, and on the morning that I used the last of it it worked the same as it always had. About two hours after that a lady came in for two extractions, and she virtually demanded the use of an anæsthetic. She wanted to know if I had cocaine. There wasn't any in the office at that time, but I said, certainly. (Laughter.) So I took this bottle and went into the laboratory and filled it with water.

A student: Sterilized water?

Mr. Hull: No, sir; ordinary water from the hydrant. I filled the bottle about half full, so that it wouldn't look like a new bottle, put a small pinch of salt in it, just enough so that there was a slightly salty taste, and then went back and injected a little of that salt solution on either side of the teeth to be extracted, and she thought she never saw any anæsthetic work nicer than that in her life. (Laughter.)

Dr. Peck: The next gentleman is Mr. Schneider.

Mr. Schneider: I did not have a chance to read Mr. Copple's paper, but obtained a few notes, which he has thoroughly covered.

I want to mention a new local anæsthetic recently presented by Parke, Davis & Co., called chlorotone. I know of a few who have used this agent and who have obtained excellent results from its use. It takes from five to seven minutes to anæsthetize the parts—somewhat longer than most other local anæsthetics. I have only had occasion to use it once for the extraction of a lower second molar root, and it worked excellently.

But one thing necessary, not only with this, but other agents used in connection with the hypodermic, is the use of pressure. It seems that this is almost as important as the agent itself.

Some of the most prominent local anæsthetics are: Cocaine hydrochlorate, cocaine cataphoresis by electricity, cocaine carbolate, eucaine hydrochlorate, campho-phenique, carbolic acid, chloral hydrate, ether absolute, ethyl bromide, ethyl chloride, ice (with chloride of sodium), menthol (peppermint camphor) and methyl chloride.

Mr. Fleming: I found my time was limited for a careful study of the subject this morning, and, as Mr. Thomas stated, there is not much to be found in the library on this particular subject.

I read Mr. Copple's paper and thought he had covered the ground thoroughly. In fact, too thoroughly for me to attempt to say anything further.

All the points of interest have been discussed. I might, however, mention one means of obtunding sensitive dentine. I have never seen it tried—only heard it mentioned. That is the use of zinc chloride. I do not know what its action is. I would like to hear this point discussed.

Dr. Peck: The last gentleman who will discuss the subject is Mr. Day. Because he is last it does not mean that he is least; very good things often come at the last.

Mr. Day: I am very glad that I came last, because there is nothing left to say. I didn't have the pleasure of reading Mr. Copple's paper, and so what studying I did was along that same line. I don't think of any points that I could add to what has already been said.

Dr. Peck: Mr. Copple will now close the discussion.

Mr. Copple: I am glad that those taking part in the discussion have taken up to a certain extent agents used as local anæsthetics. It was not the purpose of the paper to discuss the drugs used so much as to outline methods of producing local anæsthesia. Those points given by Mr. Ireland relative to the use of cocaine were very interesting.

I have used, for obtunding sensitive dentine, a saturated solution of cocaine in carbolic acid, under pressure, with quite satisfactory results. Of course, the rubber dam must fit perfectly about the neck of the tooth when this application is made.

It is said that vigorous muscular exercise just before extraction will diminish the pain. I suppose this has a tendency to draw the blood to other parts of the body, and also perhaps diverts the attention from the operation.

I wish also to state that I appreciate very much the interest the class has taken in the paper. I feel that the intelligence of the class demands a much more worthy production.

PROF. PECK'S SEVENTH LECTURE.

You will remember the announcement a week ago that we would have an exercise by the class this morning. The paper this morning is by Mr. Falloon. Subject, "Inflammation." I will state that I have had the pleasure of reading the paper and it is splendid, as all the others have been. I trust we will have good attention, and there is no reason in the world why the discussion this morning should not be excellent. Each one on the list has had an opportunity to read the paper in ample time to be prepared.

Paper by Mr. Falloon.

Inflammation—Diagnosis, Causes and Treatment.

The principle of pathological condition with which we have to deal in our practice, and the one which will give us the most trouble, is that of inflammation, or, rather, the accompanying conditions of which the inflammation is a symptom. The importance of a thorough knowledge of the subject seems to me to be sufficient to justify the spending of the hour in its discussion.

The word inflammation comes from the Latin inflammo, and means to set on fire. Inflammation is not a process that is destructive to life; it often conserves life by walling off abscess cavities, and thus preventing the spreading of the disease. Inflammation is an effort on the part of nature to throw off intruding substances.

As the subject of inflammation is rather large to treat in one short paper, we shall say very little about the purely hyperæmic stage. The progressive steps, as slight contraction of the blood vessels, followed by their dilatation, slowed current, accumulation of blood in the part, etc., are all familiar to us. Also the different types, as active and passive, physiological and pathological, and the division based on the particular group of nerves affected by the irritant, as hyperæmia of paralysis, caused by paralysis of the constrictors, and hyperæmia of irritation, caused by irritation of the dilators. We shall proceed, therefore, with inflammation proper.

There are many varieties or divisions of inflammation.

We may make the division according to the character of the exudate, and we have serous, cellular, fibrinous, hemorrhagic, suppurative and putrefactive inflammation. In case of the death of a mass of tissue we would have necrotic inflammation. But these may also be called stages in the inflammatory process.

There is also a division based on the cause, as (1) simple inflammation, produced by traumatism or some known cause, and (2) idiopathic or infective inflammation, which is the result of bacteria and their products.

Another division, based on the class of cells affected, gives us (1) parenchymatous, where the functional cells of the part are affected, and (2) interstitial, in which case the connective tissue cells are affected.

We may have acute, subacute or chronic, according to the severity or period of existence. Or we may consider the subject in relation to the source of the exciting cause, in which case we would have, (1) ectogenous inflammation, excited from the external parts of the body; (2) lymphogenous, excited from the lymph; (3) hæmatogenous, excited from the blood.

Diagnosis.

Although we are all more or less familiar with the symptoms of inflammation, especially acute local inflammation, such as redness, swelling, heat, pain and disturbed function, yet there are some conditions in connection with the diagnosis of the various forms of inflammation that we shall do well to consider.

From the color of the inflamed area we may determine its character. As a dark or purplish color would indicate stasis, a rose-red streak along the lymphatic track would denote lymphangitis; a dark red color along the course of the veins would be an indication of phlebitis, while a copper-red color would point to syphilitic inflammation. The redness in the part is, of course, due to hyperæmia, which precedes and continues throughout the inflammatory process.

The swelling which is present, and is especially noticeable in loose connective tissue, is due to the engorgement of the blood vessels, exudations from those vessels, and proliferation or multiplication of cells. The swelling is somewhat soft in acute inflammation and hard in the chronic forms.

The heat in the part is not greater than the temperature of the internal organs, but it may be greater than the normal body temperature, as in the case of general inflammation, indicated by fever.

The accompanying pain may be increased by pressure or by motion of the part. The pain is more severe in dense structures, due to the greater pressure on the nerve filaments. Pain in connection with an inflamed pulp is usually constant, as in contrast with the spasmodic or intermittent pains of hyperæmia. Another distinguishing feature between inflammation and hyperæmia is that moderate heat or cold will not increase inflammatory pain as it will hyperæmic pains. The pain is sometimes reflected, as otalgia or earache, in pulpitis; dentagra in one tooth and pulpitis in another.

Disturbance of function is noticed in the perversion or suppression of the secretions; non-sensitive parts become hyper-sensitive, as decayed dentine in vital teeth.

Fever is a constitutional symptom, and may be accompanied by general disturbances, such as headache, loss of appetite and lumbar pains, vomiting, constipation, exhaustion, etc.

Causes.

The causes of inflammation are usually considered in two general divisions—predisposing and exciting. Predisposing causes are those things which weaken the vitality of the system, and thus reduce the power of resistance. Among these may be mentioned disease, climate, excessive use of alcoholic stimulants, age, change of diet, insufficient nourishment, and certain morbid conditions of the blood, like the presence of an excess of sugar or of uric acid. Anæmic subjects are more disposed to inflammation than plethoric subjects are.

The exciting cause is an irritant of some kind which affects the vascular system in the part. The irritant may be mechanical, chemical, septic or nervous. Examples of mechanical irritants are: Foreign bodies, pressure on blood vessels, puncture, scarification, etc. Examples of chemical irritants are: Acids, alkalies, croton oil, etc. These irritate by virtue of their chemical reaction upon the tissue elements to which they are applied.

Septic irritants are living organisms—parasites—micro-organisms which irritate by their presence and the formation of poisonous ptomaines. Among these are the saprophytic germs and the pus microbes.

Nervous irritants are those which produce irritation through the medium of the nervous system.

Treatment: The first step in the treatment of inflammation is to remove the cause, or the irritant, if it has not already been removed. The treatment may be considered as prophylactic and curative. Whenever prophylactic treatment can be employed we should not fail to use it. For it is often much easier to prevent trouble than it is to right it after it has occurred.

By the use of antiseptic precautions in our operations we can do a great deal toward preventing septic inflammation. And by sedative treatment we can do much toward preventing the inflammatory process following as a result of traumatic or chemical or other injuries.

It is such preventive measures that make surgery what it is to-day, and render operations safe that would otherwise be very dangerous, if not fatal. The dentist who fails to appreciate the value of prophylactic treatment, as regards antisepsis, cannot hope to have the same degree of success in the prevention and cure of disease as those who follow antiseptic methods. The object is to ward off the intruding micro-organisms until the vitality of the part is restored and is able to defend itself against those enemies. If we can prevent the infection of a wound by microbes we shall succeed in preventing inflammation.

But we shall have a great deal of inflammation to treat which we shall have had no opportunity of preventing, in which case we must resort to curative treatment. And as irritation and inflammation sustain to each other the relation of cause and effect, the first step, as we have said before, is to remove the cause, and in many cases nature will take care of the effect. When the disturbing cause is purely local it may often be easily removed by a surgical operation, such as the removal of foreign substances, fragments of bone, the resection of the apex of the root of a tooth, the extraction of diseased teeth, the releasing of the contents of abscesses and the evacuation of pent-up secretions.

Local medicinal treatment is often indicated, and drugs for this purpose should have antiseptic and sedative properties. They may be applied externally or injected into the part, but with care not to inject enough to produce toxic effects. The amount of the agent used should never exceed that for internal use.

Local depletion for relieving blood pressure is obtained by scarifying or by incisions made with the scalpel. This is often very beneficial. But the use of leeches is not good practice, as they are so likely to carry infection.

General depletion, which was so much in vogue a few years ago, and is still occasionally resorted to, is bad practice from the fact that the resulting decrease in vitality diminishes the prospect of a favorable termination of the inflammation.

Rest is one of the essentials in the successful treatment of inflammation. As the force of gravity has considerable to do with the blood pressure, it is well to have the affected part elevated as much as is convenient to aid in the relief of pain. Cold, in the early stages of inflammation, acts very beneficially by contracting the blood vessels, and thus restoring the circulation, and by rendering the temperature unfavorable for the growth of bacteria. But in the later stages, after stasis has taken place and exudations have passed to considerable extent into the surrounding tissues, cold will prove very harmful by increasing the danger of complete stasis and death of the part, and by preventing the establishment of co-lateral circulation. Cold is best applied by means of the ice bag.

Heat is most beneficial in the later stages, as it favors co-lateral circulation, stimulates the absorption of the exudates and relieves pain. This is best applied by means of compresses, wrung out of hot antiseptic solutions, and changed as often as they become cool. The antiseptic solution should be made from sterilized water. A saturated solution of boric acid, the Thiersch solutions, or a one per cent solution of acetate of aluminum, are safe and efficacious for this purpose. Poultices are hotbeds of pollution and infection and should not be used.

A great deal can be accomplished by constitutional treatment. "When one member suffers all the other members suffer with it," and if we can strengthen the system and impart vitality to the entire organism it will prove of very great aid to the affected member or part, and in case of general inflammation, such reinforcement will prove exceedingly helpful in expelling the disease. Before stasis takes place we may lessen the blood pressure in the part by administering drugs which stimulate the vaso-constrictors (as ergot), and those which paralyze the constrictors (as aconite). But these must not be used after stasis has taken place, as they will prove harmful.

The fact that antipyretics reduce temperature at the expense of the vital forces ought to be sufficient reason for avoiding their use. The required result can be accomplished by sponging the surface of the body with tepid water, and at the same time promote elimination, without the evil results—disarrangement of the stomach, weakening of the heart, etc.—which follow the use of antiypretics. Cathartics, diaphoretics and diuretics are all useful in helping to eliminate the toxic substances which have been dispersed throughout the system by the presence of micro-organisms.

The diet should be the most nutritious possible. The starvation period in the world's history has passed, and we are learning to appreciate the necessity of sustaining the vital powers of the patient, that he may be better able to make a successful fight against that physical enemy—disease.

Those who are to follow in the discussion will give us something on the exudates and the terminations of inflammation, and other branches of the subject that I have merely touched on, and will thus add interest and profit to the discussion in hand.

Discussion.

W. F. Blair (opening discussion): Hyperæmia is defined as an accumulation of blood in a part. If physiological it passes without injury to tissue, if pathological it is apt to terminate in inflammation. I say, is apt, as restitution may take place at any stage and inflammation be avoided.

In hyperæmia we have: First, a paroxysmal pain. Second, swelling caused by serous exudate of blood, which does not coagulate, and if swelling be dented the dent remains for some time. In dentistry a case of hyperæmia may be diagnosed by the application of thermal changes, which will cause this pain to recur.

Hyperæmia always precedes inflammation, and, just previous to the inflammatory process beginning, the small arteries in the part contract for an instant, causing the flow of blood to become more rapid. When this is passed we notice the red blood corpuscles occupying the center of the blood current, while the white blood corpuscles or leucocytes occupy that part of the stream around the vessel walls. These leucocytes begin to stick to the walls, and in order to give the class a boost toward that barrel of apples I will emphasize the fact that this is the first place where we can be sure that inflammation is to follow hyperæmia.

These leucocytes continue to cling to the walls and to each other, and some of them pass through the vessel walls into the tissue. This is called diapidesis. The red blood corpuscles also begin to cling and the vessel is soon clogged; this is known as stasis.

We also have an infiltration into the tissue of a fibrinous exudate containing large quantities of fibrinogen, which coagulates, causing the swelling which comes from these quantities of exudate to be hard, and when dented with the finger does not remain dented.

Besides the swelling we find heat present; also redness and pain of a dull, heavy character.

Then as a clinical distinction between hyperæmia and inflammation, we have the difference in the kinds of pain and in the kinds of swelling, the pain in hyperæmia being paroxysmal, while that of inflammation is a continuous dull ache.

The swelling can be distinguished by the difference shown by digital pressure.

Thanking you for your attention, I will now give place to those who are to follow.

Mr. W. D. McMaster: Dr. Peck and fellow classmates: The part assigned to me to discuss is the purely hyperæmic state, but after listening to Mr. Falloon's able paper, and besides what Dr. Peck has told us in his lectures, I feel there is nothing new on the subject for me to discuss, or at least I could find nothing in the ordinary libraries but what you have all heard upon the subject of hyperæmia, and so I ask that you permit me to relate a case I had in private practice this summer, which may come more under the subject of inflammation. The patient was a cornetist in one of the Iowa state bands. The tooth that was bothering him was an upper right central. There had been in the tooth a proximal gold filling, and it had come out, and the tooth was then treated by one of the dentists in the city. He pretended to take out the pulp and fill the root canal, and did do this, and put in the filling again, and the next day the patient went back to him with so much pain that he took the filling out and took out the root-canal filling and treated the tooth and sent the patient home, and still the patient had some pain and a little pus came from the cavity, and so the dentist kept on treating the tooth for nearly a month, and still the tooth did not get well. So at last the patient came to me, and asked me to try and save the tooth, as he did not like the idea of losing it if he could help it, for fear it would interfere with his playing the cornet. So I consented to try and see what could be done. I put on my rubber dam and opened up the cavity under antiseptic precautions, and found a little pus in the cavity. I washed it out with hot carbolized water, using forty drops to half glass of water, and using this solution good and plenty. I sealed the cavity up with beechwood creosote in canal. This being done in the middle of the afternoon, about eleven that night he called me, and said, "Roll out, for I am nearly dead with pain." So I opened up again the cavity, with rubber dam in position. I took out the dressing and a little pus came out, and the gums, both labial and lingual, were badly swollen. I knew the case had been running for some time, and so took half glass hot water and to this added fifteen drops oil cassia, and took my abscess syringe and forced it up in there several times. The patient said it burned some. I now sealed beechwood creosote in the canal, and in half hour patient was free from pain. I left the treatment in for two days, and during that time the patient experienced very little pain. At the end of two days I opened up the cavity, took out the dressings and washed the cavity out with three drops of oil cassia to half glass of water, sealed in beechwood creosote and left the dressing for a week. I then took out the dressing and took my smooth broach and some cotton on it and forced some pyrozone (3 per cent solution) well up in the cavity, and sealed oil of cloves for a week. At the end of the week I followed up the same treatment that was in, and let it remain for two weeks. I took out the dressing again and repeated the treatment again with pyrozone and oil of cloves, and left it for two weeks more, and during all the time, up to my treatment just put in, the tooth was awful sore to pressure in any way, and he said it seemed three feet long at times. I treated the gums with aconite, iodine and chloroform, and reduced the swelling in the gums, and so when he returned the last time he said it had been feeling fine and no soreness whatever, so I concluded to fill the root-canal, and did, and let this go for two weeks and then put in the gold filling, and he gave me $10 for my trouble, and besides was a happy person to think the tooth had been saved. I think here is a lesson we all may profit by, and that is this, be careful in treating and filling root-canals, or you may have inflammation follow.

Mr. E. C. Moore: As I did not have the opportunity to read Mr. Falloon's excellent paper, and the time was limited, I sat down last night and wrote up a few pages on exudation, which I will read rather than disappoint you altogether.

The exudates that occur in the inflammatory process into the surrounding tissue come almost exclusively from the blood itself. The surrounding tissue contributes more or less, but the greater part of this infiltration comes from the blood.

In connection with the white blood globules into the surrounding tissue, the red blood globules also extravasate to a certain extent, but not in such large numbers as the white ones. There is also a serous exudate which takes place in connection with the blood corpuscles.

The exudates of inflammation are mainly of three varieties: First, the serous; second, the fibrinous; third, the corpuscular.

The serous exudation which takes place in connection with inflammation is not, strictly speaking, characteristic of the inflammatory process itself, but is characteristic of the process of hyperæmia. The swelling produced by the serous exudate is soft and does not coagulate.

The fibrinous exudate, a substance passing from the blood into the surrounding tissue, is strictly characteristic of the inflammatory process and does not occur in the hyperæmic process. This exudation passes from the vessel in liquid form. It holds in solution large quantities of fibrogen, which, when it passes into the surrounding parts, coagulates and becomes hard and resistant to pressure.

The corpuscular exudates which take place in the process of inflammation are mostly the leucocytes, or white blood corpuscles, with some red, while in the hyperæmic process the red blood corpuscles pass out in large numbers, the red corpuscles and the serous exudate completely filling the surrounding tissues.

Mr. F. N. Pellett: This paper is upon the termination of inflammation, which is suppuration, and I have prepared but little upon this subject, but it covers a very great field. The one who follows me in the discussion carries on the process of suppuration, and I will only touch upon the termination of inflammation.

After the acute form of inflammation has passed the bounds of resolution, its most common terminations are—induration, hypertrophy, tumefaction, suppuration, ulceration and fatty degeneration of the infiltrated tissues.

Suppuration is the most common termination of acute inflammation. It takes place in the tissues by virtue of the digestive action which the bacteria has upon them.

The direct cause of suppuration is the action of specific micro-organisms upon the tissues, the leucocytes and embryonal cells.

Induration is a hardening of the tissues.

Hypertrophy is the enlargement of a part due to constant irritation and congestion, resulting in the formation of new tissue elements of the same character.

Tumefaction (to swell), an enlargement caused by proliferation of cells and their organization into new tissues, often of a different character, resulting in the formation of tumors of various kinds—benign (mild form), malignant (dangerous).

Fatty degeneration, a process of retrograde change, by which the albuminoid elements of the tissue and the exudates are converted into granular fatty matter.

Mr. R. S. Pershing: Having had the pleasure of reading Mr. Falloon's paper previous to this time, and listening to it this morning, I feel he has very thoroughly covered the subject.

Having the opportunity to choose the part of the subject we wished to discuss, I chose the suppurative process.

Suppuration is the formation of pus, and is caused by the infection of the part by micro-organisms, the most common as well as the most virulent of which is staphylococcus pyogenes aureus.

Suppuration is the molecular death of the tissues involved, and is the liquefaction of the tissues and inflammatory exudates, according to Thayer, caused by the "peculiar peptonizing or digestive action which the micro-organisms exert upon the tissues, and also as the result of the more or less complex changes which occur in them in their office to oppose bacterial invasion."

Suppuration may be induced by the injection of pyogenic cocci into the system. They may gain entrance through a wound, be it ever so small, for I saw a case not long ago where a mere touch of an infected explorer caused quite a suppuration, by just touching the finger and not entering the tissue deep enough to draw blood, but sufficient to cause pus formation.

This should be a warning to us to sterilize our instruments and keep them as nearly aseptic as possible.

The symptoms of inflammation are pain and fever, although we cannot always depend upon these, especially if the affected portion is in the deeper parts of the body, where we cannot see or determine the presence of pus by fluctuation.

In such a case we would resort to a count of the leucocytes in the blood. Under normal conditions there are present about 7,000 or 8,000 leucocytes to the cubic m.m. of blood in adults; infants, 12,000; children, 8,000 to 9,000. In some cases they may increase to from 30,000 to 50,000 in number.

We may have a difference in the resistance of the suppurative process in different individuals, which is due to the lack of vitality or resistance on the part of one and the vitality or power of resistance of the other. May we belong to the latter class.

Mr. A. E. Schneider: Although my paper is almost a repetition of what has already been said, I will try to talk a little louder so that you may at least hear what I have to say.

After having read Mr. Falloon's paper, I thought there was one subject concerning inflammation of which the class would like to know a little more. I decided to look up a few points on antiphlogistics and the treatment of inflammation.

The word antiphlogistic is derived from the Latin anti—against, phloguzo—I burn. Quoting from Hare's therapeutics: Antiphlogistics are remedies employed to prevent the progress of inflammatory processes. They are all contraindicated in the presence of tissue possessing an impaired vitality through previous conditions of disease.

Potter says the term is becoming obsolete.

Besides this, I was able to find very little concerning antiphlogistics. A few of the drugs coming under this heading are: Aconite, digitalis, veratum viride, tartar emetic, mercury, gelsemium, ipecacuanha, potassium nitrate, rest in a recumbent position, counter-irritation, cold applications, local depletion, venesection and purgation.

Concerning the treatment of inflammation. First remove the cause, for it is useless to remove disease by treating the symptoms, which are the result rather than the cause. Local applications and perhaps constitutional remedies may relieve pain in the part. Rest is of prime importance so as to give nature a chance to fulfill her duty. Cold applications are good in the first stages of inflammation. By their use the blood vessels are again contracted, thus forcing the blood current along, inhibiting the growth of micro-organisms and decreasing pain, but they may be injurious if applied in later stages of inflammation. The main object is to prevent stasis, and this may be done by applying moist heat. It influences the lymphatics to take up the exudates, dilates blood vessels and prevents coagulation in perivascular tissue, and aborts impending alveolar abscess. The best way to apply moist heat is to take a piece of flannel, soak it in hot water, lay it over inflamed area and cover it with a towel. This process is called fomentation. If the peridental membrane is inflamed because of a dead pulp, rest is very essential. Remove septic material from the root-canal and place in your dressing. Irritation may still be continued when the teeth are brought together. If this is true, the teeth, both posterior and anterior to the affected tooth, must be dried and built up with cement, or some other material, and the patient put on a soft food diet until this soreness passes away. Counter-irritation is very beneficial in the first stages of inflammation. By using plasters, either capsicum or mustard, the blood is brought to the surface, thus relieving the deeper veins of their burden. Aqua ammonia is sometimes used for this same purpose. Saline cathartics are good, for they relieve blood pressure and act as counter-irritants by drawing blood away from inflamed part to intestines. Anodynes, diaphoretics, antipyretics and arterial sedatives may be profitably employed in certain instances. In using veratrum viride, aconite and gelsemium great care must be taken, for they are all of them poisons. In later stages, free drainage and evacuation of pus is necessary, for it causes pressure, driving the poisonous elements out into the blood, sometimes causing general fever and chills.

Dr. Peck: Now the paper and the subject is open for general discussion—any member of the class who has any thought on the subject.

Mr. H. M. Brock: I don't believe the history of inflammation has been entered into any. I think Fonheim was the discoverer of the process of inflammation. I don't remember the date. In touching upon inflammation we might look a little more thoroughly into it from the stand of the psychologist rather than that of the physiologist, and see the influence inflammation has had upon the minds of people. Take the auditory nerve, for instance, where men imagine sounds and noises, that to them seem to be objective rather than subjective. And this has had more or less influence upon the literature of our time, as is illustrated in one of Juvinel's most brilliant poems. I haven't looked this up any or read up on the subject, but in order to start the discussion I have said these few words.

Mr. Wickham: There is a thing that I would like to mention. A thing that used to bother me a good deal was how these leucocytes passed through the wall of the blood vessel when we find that the leucocytes are much larger than the openings in the blood vessel. They had an amœboid movement, but I didn't understand that movement exactly until I found it expressed in this way: Take a rubber bag filled with water and force a part of it through a hole much smaller, and then work the contents through that into the other side. That expressed it to me very clearly.

Mr. Hull: Dr. Black divides inflammation according to its duration into acute, subacute and chronic, but he makes a distinction between general inflammation and dental inflammation. He says that in acute inflammation, in the general, its duration is from three to six weeks; chronic inflammation is more than eight weeks and subacute is between six and eight weeks. And in dental inflammation the acute is from three to four days, the subacute is from four to seven days and the chronic is more than one week.

Dr. Peck: I might say that I, for one, am exceedingly glad of the opportunity to have heard this paper and the discussion. I do not know what Prof. Wiggins has done in his lectures on inflammation in connection with general pathology, but this paper has brought the subject out before you just exactly as I wanted it brought out—different phases of pathologic processes, for which I, in the time allotted me for my work, do not have time to go into the divisions and subdivisions as thoroughly as I would like.

We will call on Mr. Falloon to close the discussion.

Mr. Falloon (closing discussion): I would just like to say that when Dr. Peck suggested this subject to me my first thought was that it was an excellent subject. There was plenty of material in it. But in reading up the matter, I discovered that it was very much too large for a paper that could be read in the time that we have here, and so I have depended very much on those who were to discuss the paper to help me out in presenting this subject to the class, and I want to say that I am very thankful to those gentlemen for so ably presenting those portions that I have omitted in the paper, and have done so much to complete the discussion of this subject.

CLASS WORK.

Arsenic.

Q. Please tell the class of source of arsenic.

A. It is derived from various ores.

Q. How is arsenic obtained from these ores?

A. By the process of sublimation. By subjecting the ores to heat. The heat causes the arsenic in the ores to volatilize, which crystallizes and is thus collected throughout the vessel used for the purpose.

Q. State physical properties of arsenic.

A. A non-metal. A white crystalline powder, but upon standing it becomes milky white externally. Sweetish taste. Practically odorless; under heat it emits a garlicky odor. Soluble in water in 1 in 33 to 80 parts, according to its physical condition.

Q. What is the action of arsenic when applied to the tissues?

A. When applied in concentrated form it is a very active escharotic, and even when very much diluted it is a severe irritant.

Q. What various names have we for this substance?

A. Arsenous acid, white arsenic, acidum arsenosum. Chemical symbol $As_2 O_3$.

Q. What preparation of arsenic is mostly used in medicine?

A. Fowler's solution—liquor potassii arsenitis. Solution of Potassium Arsenite, strength 1-100.

Q. Can you tell us the proportion of these different agents, and what other agents, if any, are used to form Fowler's solution?

A. Arsenous acid 1 part, bicarbonate of potassium 1 part, water 10 parts; these are boiled together thoroughly and 3 parts compound tincture of lavender added and enough distilled water to make 100 parts.

Q. State proper medicinal dose of arsenous acid.

A. 1-30 to 1-10 grain.

Q. State proper medicinal dose of Fowler's solution.

A. Two to 10 minims.

Q. What is the action on the system of small medicinal doses of arsenic?

A. Stomachic tonic; promotes appetite and digestion; increases cardiac action, respiratory power and the secretions of the intestinal tube; stimulates mind and intestinal peristalsis; causes rotundity of form and fair skin. We find a great many ladies especially using arsenic for the purpose of beautifying themselves generally, and thus they form what is called the arsenic habit, the same as individuals form the cocaine habit, the morphine habit, etc.

Q. What is the effect of full doses?

A. Causes œdema and itching of eyelids, increased saliva, nausea, vomiting of mucus, diarrhœa and dysentery, epigastric pain and soreness, irritable and feeble heart, dyspnœa, disordered sensibility, skin eruptions.

Q. State effect of toxic doses.

A. The phenomena may be either gastro-intestinal or profoundly cerebral in character. In the first and most usual form there is burning pain at the stomach, extending over abdomen, vomiting, thirst, bloody stools, strangury, suppressed or bloody urine, rapid and feeble heart, great anxiety, cold breath, albuminuria, collapse. In the nervous form profound coma comes on suddenly without any gastro-intestinal symptoms.

Q. State proper treatment of arsenical poisoning.

A. Prompt evacuation of stomach; then the administration of the official antidote, Ferric Hydrate with Magnesia, in doses of ℥j frequently repeated. Then oil, milk or mucilaginous drinks to protect mucous membrane, and diluents, alkaline mineral waters, potassium iodide, etc., to promote elimination.

Q. How is the official antidote prepared?

A. Solution of ferric sulphate 50 Cc. in water 100 Cc. Magnesia 10 grammes rubbed up with water 750 Cc. in a bottle of 1000 Cc. capacity. When wanted shake the latter to a homogeneous magma, add it gradually to the former, and shake them together to a uniform smooth mixture.

Q. Should arsenic be administered before or after meals?

A. After meals.

Q. Why?

A. To avoid its irritating effects on the gastric mucous membrane.

Q. Is it ever advisable to administer it before meals?

A. Yes.

Q. In what cases?

A. In aggravated cases of vomiting, especially the vomiting of pregnancy.

Q. In what diseased condition is arsenic especially valuable as a therapeutic agent?

A. In stomach disorders, as gastric catarrh, chronic gastric ulcer, cancer of the stomach, etc., and vomiting due to these causes:

In diarrhœas and dysentery.
In anæmia and chlorosis.
In vomiting of pregnancy.
In malaria and typhoid fever.

Opium.

Q. What is the source of opium?

A. The concrete, milky exudation obtained by incising the unripe capsules of the White Poppy—Papaver somniferum.

Q. From what country, chiefly, is opium obtained?

A. From Turkey.

Q. In what form is this substance found in commerce?

A. At first it is in the form of a gum or resin, more or less soft; with age it becomes hardened.

Q. Is opium a complex body, chemically, or a simple body?

A. A complex body, containing 17 known alkaloids, 2 acids, 2 neutral bodies and a number of other substances of minor importance.

Q. Name some of the principal alkaloids of opium.

A. Morphina—Morphine, Codeina—Codeine, Thebaina—Thebaine, Narceina—Narceine, Papaverina—Papaverine, Narcotina—Narcotine. Morphine is the principal alkaloid.

Q. State to the class one preparation of opium.

A. Powdered opium, Opii Pulvis, dose grs. ¼—ij.

Q. Can you tell us another preparation of opium?

A. Tincture of opium—Tinctura Opii—laudanum, dose m. v-xxx.

Q. We have referred in our lectures to a form of opium called Wine of Opium, as being useful for some purposes. Please tell the class what preparation of opium this is.

A. Vinum Opii, dose same as the tincture.

Q. There are one or two other preparations of opium that we ought to be more or less familiar with; one of them is Paregoric. Can you tell us about that?

A. Tinctura Opii Camphorata—Camphorated Tincture of Opium. Dose for infant, m. v-xx; adult, ʒj-iv.

Q. What form of opium does your little book divide as to dose into three parts, for infants, children and adults?

A. Tinctura Opii Composita—Compound Tincture of Opium—Squibbs' Diarrhœa Mixture. Dose for infants, gtt. j-x; for children, gtt. x-xxx; for adults, ʒj.

Q. Name the principal preparations of Morphine.

A. Morphinæ Acetas—dose, grs. 1-20—j; Morphinæ Hydrochloras—dose, gr. 1-20—j; Morphinæ sulphas—dose, gr. 1-20—j.

Q. State the average medicinal dose of Sulphate of Morphine for an adult.

A. Gr. 1-6.

Q. What per cent of morphine does the sulphate of morphine contain?

A. Eighty per cent.

Q. State proper dose of morphine.

A. Grs. 1-20—½.

Q. State Latin phrase, dose and composition of Dover's Powders.

A. Pulvis Ipecacuanhæ et Opii; dose—gr. v-xv; composition—Ipecac 1, Opium 1, Sugar of Milk 8 parts.

Q. Please tell the class the general effect upon the system of small doses of opium.

A. A general stimulant, except to the secretory system.

Q. State effect of medium doses.

A. Dries all the secretions except those of the breasts and skin, these being increased; produces dryness of mouth and throat, arrest of gastric secretion, retarded digestion, anorexia; stimulates brain, increases heart action, raises arterial tension; pupils slightly contracted; the mind, at first stimulated, becomes calm; sleep follows.

Q. State effect of full doses.

A. Arrests digestion; causes nausea and vomiting; greatly increases the sweat, prevents the conductivity of the nerves; depresses heart and circulation; causes intense pruritus, especially of the nose; often retention of urine, and soon profound sopor, leaving, as after effects, nausea, depression, constipation, vertigo, anorexia, nasal pruritus, fetid pathological secretions.

Q. State symptoms of toxic doses.

A. Produces cold, clammy sweat, very slow heart, abolished reflexes, coma; pupil minutely contracted, but dilated as the end approaches, death occurring from suspension of respiration, due to the direct action of the poison on the respiratory centers in the medulla.

Q. There is an artificial alkaloid connected with these drugs. What is it?

A. Apomorphina; apomorphine.

Q. How is this produced?

A. By the action of HCl on morphine.

Q. For what purpose is it especially used?

A. It is a powerful emetic.

Q. What is the proper dose by way of the stomach?

A. One-eighth of a grain.

Q. And hypodermically?

A. One-sixteenth of a grain.

Q. What are the chief indications in the treatment of opium poisoning?

A. To evacuate the stomach, to maintain respiration and to keep up the circulation.

Q. What drug is probably the best antidote to opium or morphine in the stomach?

A. Potassium permanganate, in doses one-half greater than the amount of the drug ingested.

Q. Is atropine of any value in this connection?

A. It is. It antagonizes the cerebral action of opium; also its action on the pupil, respiration, heart, and regulates arterial tension.

Q. How should atropine be administered, and what is the proper dose?

A. It should be given hypodermically. One one-hundred-twentieth of a grain every fifteen minutes for three administrations.

Q. What other drugs are especially useful as physiological antagonists?

A. Strychnine, coffee, caffeine and cocaine.

Q. Are faradization (especially of the chest muscles), cold affusions and artificial respiration of any value?

A. They are.

Q. How about flagellation?

A. This should not be used; it is too exhausting.

Q. Is there anything else of importance in this antidotal treatment?

A. There is; the bladder should be evacuated to prevent reabsorption.

Q. How does the action of morphine compare with that of opium?

A. Morphine is more anodyne and hypnotic. It causes more intense pruritus, but is less stimulant, less convulsant, less constipating and less diaphoretic.

Q. Name six cardinal indications for the use of opium.

A. To relieve pain (except in acute inflammation of the brain); to produce sleep; to allay irritation; to check excessive secretions; to support the system (in wasting diseases), and as a sudorific.

Q. Name a few diseased conditions in which opium is of special therapeutic value.

A. Low fevers, accompanied with insomnia and delirium. In diarrhœa, dysentery and enteritis. Colds and muscular rheumatism (Dover's powders). Cholera morbus. Serous inflammations and cardiac diseases.

Q. In what conditions should opium not be used?

A. Alcoholism; diseases of the respiratory organs, and some forms of cerebral congestion.

Q. What is the chemical composition of morphine?

A. $C_{17}H_{19}NO_3$.

Cocaine.

Q. Please tell the class the source of cocaine.

A. From the leaves of the *Erythroxylon Coca*.

Q. Where does this plant or shrub grow chiefly?

A. In Peru and other South American countries.

Q. State the principal preparations obtained from Coca, with dose of each.

A. *Cocainae Hydrochloras*, Cocaine Hydrochlorate, dose internally, gr. ⅛-j; hypodermically, gr. ⅛-½. *Cocainae Oleas*, Oleate of Cocaine, a ten per cent solution of the alkaloid in Oleic Acid, for external use only. Extractum Cocæ Fluidum, Fluid Extract of Coca, dose ʒss-ij.

Q. What is the physiological effect of small medicinal doses of Cocaine?

A. A general stimulant to the system; cardiac stimulant; cerebral stimulant; diuretic; increases respiratory power; increases appetite, aids digestion.

Q. What is the effect of larger doses of this drug?

A. In larger doses the effect of the drug upon the system is exactly the opposite to that of small doses. It acts as a depressant upon all the various organs upon which it acts as a stimulant in small doses.

Q. What is the effect of poisonous doses?

A. The pulse, at first quick and forcible, becomes small, rapid and intermitting, the heart apparently standing still in systole once in every 10 to 12 beats. Respiratory depressant. Produces cold, clammy sweat; patient becomes emaciated, weakened; step unsteady, pupil dilated; breath bad; teeth become encrusted with green stain. Death occurs in animals by paralysis of respiration, but in man there seems to be a tetanoid spasm of the cardiac muscle, which is equally dangerous to life.

Q. What shall be our antidotal treatment of systemic cocaine poisoning?

A. Amyl-nitrite combats the earliest symptoms of cardiac depression; alcohol and opium stimulate the heart. The most direct antagonist is chloral, so also are chloroform and ether. Morphine is also good. It is of the utmost importance to admit plenty of fresh air and to keep the patients on their feet and moving.

Q. Tell something of the characteristics of amyl-nitrite and how it is best administered.

A. A clear, yellowish, oily liquid, very volatile, and insoluble in water. It is produced by the action of Nitric or Nitrous Acid upon Amylic Alcohol. It may be administered internally or by inhalation, the latter method being the better, as it is insoluble in water its effects will be very largely lost when given by way of the stomach.

Q. If given internally what is the proper dose?

A. Minims ii-v.

Q. What is its chemical symbol?

A. $C_5 H_{11} NO_2$.

Q. Tell us something about Chloral.

A. Chloral itself is Tri-Chlor-Aldehyde ($C_2 HCl_3 O$), an unstable, oily, colorless fluid, formed by the action of Chlorine upon Alcohol. Its hydrate, the official Chloral ($C_2 HCl_3 O+H_2 O$), is a white crystalline solid, and is the form that should be used in medicine.

Q. State the proper dose of Chloral Hydrate.

A. For a healthy adult, gr. xv-xx. The dose varies, however, with the susceptibility of the individual and with the presence or absence of cardiac and pulmonary disease.

Q. Is cocaine considered in any sense a nutrient to the system?

A. It is.

Q. Please explain.

A. It is a diuretic, but lessens the quantity of urea by checking the process of waste, thus acting as an indirect nutrient to the system.

Q. What is the explanation as regards lack of hunger while cocaine is being used?

A. Some authors claim that it simply paralyzes the nerve endings in the gastric mucous membrane, and others claim it serves as a nutrient to the system.

Q. The power of cocaine as a local anæsthetic is very great over a limited area of tissue; please tell the class how it thus acts.

A. Some authors claim it paralyzes the nerve filaments, and others claim its action is a vasomotor one, rendering the nerve filaments bloodless, thus destroying their power to transmit sensation.

Q. How and for what purpose do the natives of South America use this drug?

A. They chew the coca leaves, mixed with a little ashes or lime, to increase their physical endurance while performing arduous labors.

Q. What is the proper medicinal dose of coca leaves?

A. ʒ ss-ji.

Escharotics, Styptics, Hæmostatics.

Q. Please tell the class the definition of *escharotics*.

A. Agents which destroy the soft parts to which they are applied.

Q. Is there any other name that is used synonymously with the word escharotic?

A. Yes; *caustic*.

Q. Please tell the class in what way escharotics bring about the destruction of the soft parts.

A. By taking the water from the parts; by action of a corrosive oxidation.

Those agents which destroy the tissue by taking away the water may be said to act in a chemical way; those which destroy the tissues by a corrosive oxidation, causing direct destruction, may be said to act dynamically.

Q. What do you mean by oxidation of the tissue?

A. The process of burning of the tissue.

Q. Please name the principal agents under these classes.

A. Potassa, lime, arsenous acid, zinc chloride, silver nitrate, corrosive sublimate, mercuric nitrate, mineral acids, bromine, zinc and copper sulphates, carbolic acid, chromic acid.

Q. Please state to the class a short, concise definition for *styptics*.

A. Agents used to arrest hemorrhage.

Q. Please tell the class in what way *styptics* are used.

A. They are used *locally*, applied to the bleeding parts.

Q. Please tell the class how these agents stop hemorrhage.

A. By causing clot formation, and by causing the muscular walls of the blood vessels to contract, thus closing the opening of the vessels.

Q. Please define *haemostatics*.

A. Agents to be used *internally* for the purpose of arresting hemorrhage.

Q. Please tell the class how hæmostatics act.

A. Their action is physiological; a vaso motor action, acting upon the nerves which control the blood vessels, causing the muscles in the latter to contract.

Q. Please mention what you can of the principal *styptics*.

A. Acids, Alum, Ferric Chloride, Ferric Sulphate, Zinc

Sulphate, Lead Acetate, Silver Nitrate, Spider's Web, Tannic Acid, Cold, Vegetable Acids.

Q. Please mention some of the principal agents to be used as *haemostatics.*

A. The dilute Mineral Acids, especially Sulphuric, d-*m* v-xv; Gallic Acid, d-gr. v-xv; Ergot, d-gr. x-ʒj; Digitalis, d-gr. ss-iij; Hamamelis(*Extractum Hamamelidis Fluidum,* d-*m* j-ʒj); Ipecac (*Extractum Ipecacuanhae Fluidum,* d-*m* j-v); Lead Acetate, d-gr. ss-v; Oil of Turpentine, d-*m* v-xv.

Astringents, Antiphlogistics, Diaphoretics, Sudorifics.

Q. Please define Astringents.

A. Agents which act by contracting muscular tissue and cause condensation of other tissues; also lessen secretion from mucous membranes.

Q. Have we different classes of Astringents?

A. Yes; Remote and Local.

Q. Please tell the class the manner of action of Remote Astringents; upon what organs do they act and how is the action brought about?

A. They are systemic agents, to be taken internally, and act upon internal organs through the circulation.

Q. Name the principal systemic astringents.

A. Gallic Acid, d-gr. v-xv; Sulphuric Acid (dilute), d-m. v-xv; Lead Acetate, d-gr. ss-v.

Q. Please tell the class how Local Astringents act.

A. They act only upon the part to which they are applied.

Q. Please name as many Local Astringents as you can.

A. Tannic Acid, Alum, salts of Bismuth, Lead, Copper, Zinc, Cadmium, Per. Salts of Iron, Galls, Mineral Acids.

Q. Please tell the class how mineral acids should be prepared when thus used.

A. Very dilute.

Q. Can you tell us, as regards anatomical location, what other kind of Astringents we have?

A. Intestinal Astringents.

Q. Please name the principal agents of this class.

A. Dilute Mineral Acids; Acetic Acid (dilute), d ʒj-ij; Silver Nitrate, d. gr. 1-6-½; Tannic Acid, d. gr. 1-xx; Zinc Oxide, d. gr. 1-x; Copper Sulphate, d. gr. 1-6-½.

Q. Please tell the class upon what two active principles the Vegetable Astringents largely depend for their efficiency.

A. Tannic and Gallic Acids.

Q. Please define *Antiphlogistic.*

A. Any *medicinal agent* or *method* used to reduce inflammation.

Q. Are there certain drugs best suited to reduce inflammation of certain parts?

A. Yes; Mercury (*Gray powder*), d. gr. ss-x, and Opium for inflammation of serous membranes; Aconite (Tr. d-m. ss-iv) and Antimony (Wine of, d-m. v-xv) for the respiratory apparatus.

Q. Mention all you can of other agents or means that are proper to use as antiphlogistics.

A. Ipecac (*powdered-root,* d. gr. ss-ij), Digitalis (*extractum digitalis,* d. gr. 1-6-½), Ergot (*extractum ergotae fluidum,* d. ʒss-ij), Venesection, Local Depletion, Purgation, Counter-irritation, Cold, Rest in Recumbent Position.

Q. Define *Diaphoretics* and *Sudorifics.*

A. Agents used to promote perspiration.

Q. Is there any difference in the use of these two words?

A. Sudorifics act more energetically than Diaphoretics.

Q. We have these agents divided according to their manner of action into separate classes. What is the first class?

A. Simple Diaphoretics.

Q. Please tell the class how these agents act.

A. They enter into the circulation of the blood and stimulate the sudoriferous glands while in action.

Q. Please name as many as you can of the agents used as Simple Diaphoretics.

A. Alcohol, Camphor,(Spiritus Camphoræ, d-m. v-xv), Sulphur (*sulphur precipitatum,* d. gr. x-ʒj), Sweet Spirits of Nitre (d. ʒss-℥ss), Jaborandi (*extractum pilocarpi fluidum,* d-m. v-ʒj), Spirit of Mindererus (*Liq. ammonii acetates,* d. ʒj-℥j).

Q. We have another division of Sudorifics; what is it?

A. Nauseating.

Q. Please tell the class how Nauseating Sudorifics act.

A. By dilatation and relaxation of the capillary vessels.

Q. Please name as many agents under this division as you can.

A. Tobacco, Opium, Tartar Emetic (d. gr. 1-16-¼), Ipecac, Dover's Powders (d. gr. v-xv), Lobelia (tinctura lobeliæ, d-m. v-xxx).

Q. We have another division of Sudorifics; what is it called?

A. Refrigerant.

Q. Please tell us how they act.

A. By reducing the force of the circulation of the blood, and probably by a specific action on the sweat center in the medulla.

Q. Please name the principal agents under this division.

A. Potassium and ammonium salts, Aconite, Veratrum (tr. d-m. ij-x), Cocaine, Tobacco, Jaborandi, Ether, Nitrites of Amyl (d-m. ¼-j, dissolved in alcohol), of Potassium (d. gr. ½-v).

Antipyretics, Analgesics or Anodynes.

Q. Please define Antipyretics.

A. Agents used especially to reduce *high body temperature.*

Q. Please tell the class what is meant by "high body temperature."

A. A rise of temperature in the system above that of the normal.

Q. Please tell the class about inflammation as regards heat.

A. In inflammation the manifestation of excess of heat is confined to the part inflamed.

Q. Does the temperature present in inflammation exceed in degree the normal temperature of the body?

A. It very often does, but it does not exceed the normal temperature of the blood. The temperature manifested in inflammation is simply due to an undue quantity of blood in the part; not because the blood is overheated.

Q. Antipyretics act in different ways. Please state two general lines or principles of action of these agents.

A. 1st, by lessening *heat production;* 2d, by promoting *heat loss.*

Q. In what ways may the action of Antipyretics be brought about in lessening "heat production?"

A. By preventing *tissue change* and by reducing the *circulation.*

Q. In what way will the prevention of tissue change do away with heat production?

A. By preventing oxidation. We find heat generated to a greater or less extent where oxidation is being carried on.

Q. How many modes of action are there under the second division, *promoting heat loss?*

A. Three.

Q. Mention the first one.

A. A dilatation of the capillary system of blood vessels.

Q. What is another subdivision under this head?

A. Promoting perspiration.

Q. And a third?

A. Abstracting heat from the body.

Q. Please tell the class what dilatation of the capillary system of vessels has to do with the elimination of heat from the body.

A. It favors heat radiation.

Q. Please explain to the class how inducing perspiration will effect a loss of heat.

A. The perspiration evaporates and cools the entire system.

Q. Please tell the class as many agents, properly classed under antipyretics, as you can.

A. Quinine (*quininae sulphas* d. gr. i-xx), Alcohol, Carbolic Acid (d. gr. ¼-j), Aconite (*tinctura aconiti,* d-m. ½-iv), Nitrous Ether (*spiritus aetheris nitrosi,* d. ʒss-℥ss), Antipyrin (d. gr. j-xxx), Digitalis (tr. d-m. v-ʒj), Salicin (d. gr. xx-ʒij), Cold Drinks, Ice to Body, Cold Bath.

Q. Please define Analgesics or Anodynes.

A. Agents used to relieve pain.

Q. Name the classes of these agents as regards their action.

A. General and Local.

Q. Please tell the class how Local Analgesics bring about results, and if they act in more than one way explain.

A. By direct depression of the terminal nerve organs in the skin; also by reducing the local circulation and in that way taking away the power of the nerves to transmit sensation, or robbing them of their supply of oxygen—nourishment—and in this way reducing their ability to transmit pain.

Q. Please tell the class how General Analgesics are used and what parts of the system they affect.

A. They are taken *internally* and affect the *entire organism* through the medium of the circulation of the blood.

Q. Please name as many agents, properly used as Local Analgesics, as you can.

A. Opium, Belladonna, Carbolic Acid, Cocaine, Aconite, Chloroform, Eucaine.

Q. Please name as many General Analgesics as you can.

A. Opium, Belladonna (*tinctura belladonna,* d-m. j-xxx), Aconite (*tinctura aconiti,* d-m. ½-iv), Antipyrin (d. gr. 1-xxx), Chloral (hydrate, d. gr. v-xv), Antikamnia (d. gr. v-x).

Irritants, Tonics, Stimulants.

Q. Please state definition for *irritants.*

A. Agents which, when applied to the parts, produce more or less vascular excitement.

Q. Irritants are sometimes called *counter-irritants.* Please explain to the class just what is meant by counter-irritants.

A. Agents the effects of which are manifested at some place more or less remote from the seat of inflammation.

Q. Are irritants divided into separate classes or groups according to the effects produced, and if so, how many?

A. Yes; they are divided into three classes.

Q. Name the first one.

A. *Rubefacients.*

Q. Please define rubefacients.

A. Agents which cause redness or congestion of the skin.

Q. Please name the principal agents under this group.

A. Mustard, camphor, iodine, pitch, turpentine, capsicum, ammonia.

Q. Is there any danger in the use of this class of irritants?

A. Yes; if the stronger ones are held in contact with the skin too long they will cause a destruction of the tissue.

Q. Please state the names of the second group of these agents.

A. *Epispastics, vesicants or blisters.*

Q. Please tell the class the results from the use of these agents.

A. They cause decided inflammation of the parts to which they are applied and an outpouring of serum.

Q. Please state as many agents under this division as you can.

A. Cantharides, mezereon, euphorbium, oils of cassia and cinnamon.

Q. What is the third division of these agents?

A. *Pustulants.*

Q. Please tell the class the action of pustulants.

A. Agents which affect isolated parts of the skin, as the orifices of the glands, giving rise to pustules.

Q. Name as many agents under this division as you can.

A. Croton oil, tartar emetic, ipecacuanha, silver nitrate.

Q. Please state definition for *tonics.*

A. Agents which improve the tone of the tissues on which they have specific action, increasing the vigor of the entire system.

Q. Please name the principal agents under tonics generally.

A. Strychnine, quinine, iron, vegetable bitters.

Q. I want to direct your attention especially to cardiac tonics this morning. Please tell the class how *cardiac* tonics act.

A. In small doses they stimulate the muscular fibers of the heart, slowing and increasing the force of the heart's action.

Q. What is the danger from large doses?

A. Large doses produce irregular action of the heart and may cause death by syncope.

Q. What are the principal agents under this division?

A. Strychnine, digitalis.

Q. Please tell the class what is meant by *stimulants.*

A. The term is properly employed when used to designate the action of any agent which increases the organic activity of any part of the organism.

Q. Please tell the class what is meant by *diffusible* stimulants.

A. Diffusible stimulants are those which produce results promptly but endure for a short time.

Q. Please name agents under this division.

A. Alcohol, ammonia, camphor, ether.

Q. Please tell the class the action of *cardiac* stimulants.

A. Agents which increase the force and frequency of the pulse.

Q. Please name the principal *cardiac* stimulants.

A. Ether, alcohol, heat, ammonia, atropine, cocaine, morphine, nitro-glycerine, chloroform, aromatic oils, nitro-glycerine.

Q. Please tell the class on what part of the organism respiratory stimulants act.

A. They act more especially on the respiratory centers in the medulla, producing results through the nervous system.

Q. What are the most commonly used *respiratory* stimulants?

A. Strychnine, atropine, thebaine, digitalis, ammonia, heat, electricity, opium in small doses.

Quinine, Hematics, Restoratives, Antiperiodics, Cathartics or Purgatives.

Q. Please state the source of quinine.

A. From the bark of the cinchona calisaya.

Q. Please tell the class of what countries chiefly this tree is a native.

A. The Andes countries of South America. Possibly Colombia has produced in the past more than any other one.

Q. Is this tree grown now in any other places to any extent?

A. Yes; in the islands of Ceylon and Java, and in Burma and India.

Q. Can you tell us something about the composition of cinchona bark?

A. It contains 21 natural alkaloids (of which 4 are official), 8 artificial alkaloids, 2 simple acids and 2 tannic acids.

Q. Do the barks from the various trees differ as to color and yield of quinine?

A. They do. The *yellow* bark yields most quinine. The *pale* bark most cinchona. The *red* bark about equal parts of each.

Q. What per cent of quinine do these barks yield?

A. From two and a half to eight per cent.

Q. State physical characteristics of quinine.

A. A white amorphous or minutely crystalline powder, of alkaline reaction and very bitter taste, soluble in 1,600 parts of water and 6 of alcohol at 59 degrees F., in 25 of ether, 5 of chloroform, and readily in dilute acids.

Q. What is perhaps the principal preparation of quinine—that most used in medicine?

A. Quininæ sulphas—sulphate of quinine.

Q. State physical characteristics of sulphate of quinine.

A. Very light, snow white, fragile crystals, of very bitter persistent taste, soluble in 700 parts of water and 65 of alcohol at 59 degrees F., in 30 of boiling water. Dose, gr. 1-xx, or even gr. XL. in special cases.

Q. In the use that we as dentists will make of this drug (quinine) for various conditions, neuralgia, etc., how will it be best to use it, in large or small doses?

A. In small doses, frequently repeated, as a rule. In cases of neuralgia of long standing a large dose oftentimes produces best results.

Q. Mention two other preparations of quinine that are often used in medicine.

A. Quininæ hydrochloras (muriate of quinine), quininæ bisulphas (bisulphate of quinine).

Q. Is there any essential difference as to the doses of these various preparations?

A. There is no essential difference.

Q. State the various actions of quinine.

A. Quinine is a bitter tonic, antiperiodic, antimiasmatic and antipyretic.

Q. Please state definition for hematics.

A. Agents which increase the hematin of the blood by enriching its red corpuscles, thus restoring quality of that fluid.

Q. What are the principal agents used as hematics?

A. Iron (*Ferrum Reductum*, D. gr. j-v) and manganese (*Mangani Sulphas*, sulphate of manganese, D. gr. ij-v).

Q. Can you tell us to what general class or group of agents hematics belong?

A. To restoratives.

Q. Please state two or three other groups or agents or materials that are properly classed under restoratives.

A. Foods, tonics and some stimulants.

Q. Please state definition for antiperiodics.

A. Agents which check the progress of certain periodically recurring diseases, lessening the severity of their paroxysms and preventing their return by a toxic action upon the microbes, whose presence in the blood is supposed to cause the disease.

Q. Please tell the class some of the agents under this division.

A. Quinine, Salicin (*Salicinum*), D. gr. xx-ʒij, iodine and eucalyptol.

Q. Please state definition for diluents.

A. Indifferent substances, which, being absorbed, pass readily through the system, diluting its fluids and excretions.

Q. What is the chief agent under this class?

A. Water.

Q. Please state definition for cathartics or purgatives.

A. Agents which hasten intestinal evacuation.

Q. This class of agents is subdivided into a number of groups according to the various degrees and modes of action. What are those called which act most mildly?

A. Laxatives or aperients.

Q. Can you state the typical agents under this class?

A. Sulphur, magnesia, figs, prunes, tamarinds, candy cascarets, etc.

Q. The second division is called what?

A. Simple purgatives.

Q. As compared with the action of the former group what can you say?

A. They act more energetically, cause active peristalsis, some irritation and griping.

Q. Name the agents under this division.

A. Senna, extractum sennæ fluidum, D. ʒj, rhubarb, calomel, D. gr. 1-20-x, castor oil, aloes, D. gr. j-v.

Q. The third division is called what?

A. Drastic purgatives.

Q. As compared with the action of the former groups what can you say?

A. These act still more intensely than the other two, causing large watery stools and much griping pain and tenesmus.

Q. Please name as many agents under this group as you can.

A. Jalap, abstractum jalapæ, D. gr. i-v, colocynth, extractum colocynthidis, D. gr. ½-ij, elaterium, D. gr. 1-20—1-12, gamboge, D. gr. ij-v, croton oil, D. M. 1-3-ij.

Q. The fourth division is called what?

A. Saline cathartics.

Q. What can you say about their action?

A. They increase peristalsis, promote osmosis, stimulate the intestinal glands and thus produce free watery evacuations.

Q. Please tell us some of the agents under this division.

A. Sulphate of magnesia, or "Epsom salts," D. ʒj-℥j, potassium and sodium sulphates, sodium phosphate, potassium tartrate and bitartrate, sodium and potassium tartrate, D. ℥ss-j. This division is one that you will have occasion to prescribe in connection with your work as dentists whenever it is desirable to prescribe anything of this nature, saline cathartics almost invariably in connection with the various conditions with which you have to deal.

There is one that I think is not in your books, but it is one that you buy in the drug stores put up in two powders (Seidlitz powders), which are exceedingly useful.

Q. There are two other divisions of cathartics; can you name them?

A. Hydragogue purgatives and cholagogue purgatives. The first class include the most active of the drastic and saline classes; the latter stimulate the flow of bile, as podophyllin, aloes, rhubarb and the mercurials.

Strychnine, Cassia and Cinnamon.

I have with me this morning a specimen of yellow cinchona bark that I want you to pass around. Also specimens of cassia bark from Cochin, China. These pieces have been more or less broken up. As it occurs in commerce usually it forms round rolls and I want you to notice especially the texture of that bark. I was unable this morning to secure any bark of Ceylon cinnamon, but will have some at some future date. I have also a bottle of oil of cassia, such as is taken from this bark, the variety that comes from China. And here is a sample of oil of Ceylon cinnamon, the variety that comes from the islands of Ceylon. I want you to compare carefully these two oils, the different odor, the different physical appearance, etc., of the two oils, as you will find in the future a great many look upon oil of cassia and oil of cinnamon as one and the same article; but, as we shall learn this morning, there is a great difference between the two oils. I have also a sample of oil of myrtol, which belongs in this class of stimulating essential oils.

Q. Please tell the class the source of strychnine.

A. From the seeds of the *strychnos nux-vomica*, an East Indian tree.

Q. Please tell the class something about the physical appearance of strychnine, taste, etc.

A. A crystalline substance, intensely bitter, of alkaline reaction, soluble in 6 of chloroform, 110 of alcohol and 6,700 of water.

Q. What is a proper dose of strychnine?

A. Gr. 1-60 to 1-20.

Q. What would be the general effect upon the various organisms of the system of small medicinal doses of strychnine?

A. As a general stimulant.

Q. Tell the class all you can about the action of full doses, gr. 1-16.

A. Pupils dilated, muscular spasms, respiration spasmodic, the lower jaw stiff, a sensation of cerebral tension, shuddering and anxiety; the face wearing an unmeaning smile.

Q. State the action of toxic doses, gr. ½ (for an adult).

A. Quickly produces heightened reflexes; tonic spasms, especially of the extensor muscles, on the least irritation quickly succeed each other with intervals of repose, resulting after two or three hours in death.

Q. Tell us how death is produced.

A. Death results by asphyxia, from tetanic fixation of the muscles of respiration, consciousness being preserved until carbonic acid narcosis sets in.

Q. State proper treatment for strychnine poisoning.

A. The antidote is tannic acid, to form the insoluble tannate. Then emetics or the stomach pump, followed by perfect quiet, which is very important. *Antagonists* are chloral, chloroform, chamomile oil and tobacco. The bladder must be frequently evacuated to prevent reabsorption.

Q. Please tell the class the source of cassia.

A. It is extracted from the bark of the cinnamomum cassia, a tree which grows in Cochin, China. You will find connected with the name of the tree that grows in China the word *cassia*. You do not find the word cassia connected with the name of the variety that grows in the islands of Ceylon. Another expression, *cinnamomum saigonicum*, applied to the bark such as you have seen this morning, from the *cassia tree of China*. It is a coarse grain, rough variety. It is thick. Very frequently we find the bark in commerce two or three times thicker than any specimen you have seen this morning; while the bark from the Ceylon cinnamon tree is very thin, comparatively, and of a much finer texture. The tree itself in every way presents a finer appearance than the cassia tree, as to its general make up; every fiber, not only in its bark, but in its wood, is of a finer grain, closer texture, a different tree altogether, except in the general outward appearance, size of tree, size of leaves, etc. The bark from the tree of Ceylon is called *cinnamomum Zeylanicum.*

Q. From what part of the trees are these taken?

A. Always from the inner barks of the trees.

Q. Is cinnamon a good agent for any purpose aside from treating diseased conditions about the mouth?

A. It is used as a carminative, to correct gaseous troubles of the stomach. It is used in uterine hemorrhages in connection with sulphuric acid. In connection with quinine it is very useful for checking diarrhœas.

Q. Can you tell the class any of the preparations of cinnamon?

A. Cinnamon water. D. indefinite.

Q. Can you tell us what per cent strength cinnamon water is?

A. Two-tenths of one per cent of the oil.

Q. Can you name another preparation of cinnamon aside from the cinnamon water?

A. Tincture of cinnamon; 10 per cent strength. D. ʒss-ij.

Q. Is that of the bark or of the oil?

A. Of the powdered bark. D. ʒss-ij.

Q. Can you tell us another preparation?

A. Spirits of cinnamon; 10 per cent strength of the oil; especially useful as a carminative. D. Mv-xxx.

Q. Please name another preparation of cinnamon in the form of a powder.

A. *Pulvis aromaticus*, aromatic powder, composed of cinnamon 35 parts; ginger 35; cardamon 15, and nutmegs 15. D. gr. x-xxx, as a carminative.

Q. Were you able to find the source of oil of myrtol?

A. From the leaves of the *Myrtus Communis*, the myrtle, by distillation.

Q. Is the myrtle a vine, shrub or tree?

A. It is an evergreen shrub of the Mediterranean regions and the tropics.

Emetics, Anti-Emetics, Cerebral Excitants, Deliriants, Cerebral Depressants, Narcotics, Hypnotics, Oil of Cloves, Beechwood Creosote.

Q. Please state to the class a definition of Emetics.

A. Agents which cause evacuations of the stomach, or vomiting.

Q. Emetics are divided into two groups; what are they?

A. Local and General.

Q. Please tell the class how Local Emetics produce results.

A. By irritating the end organs of the gastric, œsophageal and pharyngeal nerves, and by reflex irritation of the vomiting center.

Q. Please mention some of the principal Local Emetics.

A. Alum (D. for an adult a teaspoonful, for a child ʒj), Mustard (Commercial Flour of Mustard, D. ʒij-iv), Salt, the Sulphates of Zinc (D. gr. x-xxx), Copper (D. gr. ij-v) and Mercury (D. gr. ij-v). Tepid water in quantity.

Q. Please tell the class in what way Systemic or General Emetics act.

A. By direct irritation of the vomiting center in the medulla, through the medium of the circulation of the blood.

Q. Please name some of the principal General Emetics.

A. Ipecac, Apomorphine, Tartar-emetic, Veratrine, Squill, Senega.

Q. Can you tell the class something of the physiology of vomiting?

A. It is an evacuant act which consists in compression of the stomach by the simultaneous spasmodic contraction of the diaphragm and abdominal muscles; the relaxation of its cardiac orifice by contraction of the radiating muscular fibers in the gastric wall. If both acts occur at the same time the contents of the stomach are expelled and vomiting occurs; if, however, the two acts do not take place simultaneously, the contents of the stomach are retained, and the abortive efforts are called *retching*.

Q. Please state definition for Anti-emetics.

A. Agents which prevent or lessen nausea and vomiting.

Q. In how many ways may Anti-emetics act?

A. Their action may be either Local or General.

Q. Please tell the class how the Local division acts.

A. By a local sedative action upon the end-organs of the gastric nerves. These are called Local Gastric Sedatives.

Q. How do the General Anti-emetics produce results?

A. By reducing the irritability of the vomiting center in the medulla. These are called General Sedatives.

Q. Name some agents used as Local Anti-emetics.

A. Arsenic (D. gr. 1-30, 1-10), Bismuth (Subnitrate, D. gr. x-ʒj), Ice, Alcohol (small doses), Opium (Pulvis Opii, D. gr. ss-j), Alum (D. gr. x-xx), Cocaine (D. gr. ⅛-j), Creosote (D. Mj-iij), Ipecac (D. gr. j-v).

Q. Is the first action of Opium to produce vomiting, or not?

A. Whenever vomiting is produced by Opium it is a secondary result of the action of the drug.

Q. Please name the General Sedatives.

A. Alcohol, Opium, Chloral Hydrate (D. gr. v-x), Amyl Nitrite (Inhalation), Bromides, Nitroglycerine (D. of Spiritus Glonoini M. ss-x), Hydrocyanic Acid (D. of Acidum Hydrocyanicum Dilutums, M. j-v).

Q. Please state definition for Cerebral Excitants.

A. Agents which exalt the functional activity of the Cerebrum without causing any subsequent depression or suspension of brain function.

Q. Name some agents under this division.

A. Camphor (D. gr. j-xx), Cannabis (Ex., D. gr. 1-6—j), Valerian (Abs, D. gr. v-xx), Caffeine (D. gr. j-v), Cocaine (D. gr. 1/8-j), Tobacco, Strychnine (D. gr. 1-60—1-20), Theine (D. gr. j-v) and Alcohol (in small doses).

Q. Please state definition for Cerebral Deliriants.

A. Agents which excite the functional activity of the higher brain to such a degree as to disorder the mental faculties and produce intellectual confusion, loss of will power, delirium and even convulsions.

Q. Mention some agents under this division.

A. Belladonna (Abs. root, D. gr. 1-10—j), Stramonium (Ext., D. gr. 1-6-1/2), Cannabis Indica (Ex., D. gr. 1-6—j), Hyoschamus (Ext., Fl., D. M. v-xx), Opium (at first), Chloral (Hydrate, D. gr. xv-xx), Alcohol (in full doses), Lupulus (at first, Tr., D. ʒj-ij).

Q. Please state definition for Cerebral Depressants.

A. Agents which lower or suspend the functions of the higher brain after a preliminary stage of excitement.

Q. Cerebral depressants include what classes of agents?

A. Narcotics, General Anæsthetics, Hypnotics and many of the Anti-spasmodics.

Q. How do these agents act?

A. They act upon the cells of the convolutions, at first stimulating the Cerebral functions, then produce stupor, coma and insensibility.

Q. Name chief agents of this division.

A. Alcohol (in large doses), Opium, Chloroform, Bromides, Chloral.

We now come to two divisions, of which I want you to have a clear conception, because you will find many using the two terms synonomously—Narcotics and Hypnotics.

Q. Please state definition for Narcotics.

A. Agents which lessen the relationship of the individual to the external world (Brunton). They at first excite the higher brain and soon cause profound sleep, characterized by increasing stupor and—if the dose is sufficient—coma, insensibility and finally death by paralysis of the centers in the medulla which govern respiration and the other functions of organic life.

Q. Mention some of the agents properly classed under this division.

A. Opium, Belladonna, Cannabis Indica, Alcohol, Chloral, Chloroform, Ether, Humulus.

Q. Please state definition for Hypnotics.

A. Agents which, in proper doses, induce sleep, without causing deliriant or narcotic effects.

Q. Have any of these agents the action of the other class of agents, especially in large doses?

A. Yes, many of the most efficient hypnotics act as narcotics in full doses.

Q. Please name some of the principal agents under Hypnotics.

A. Sulphonal (D. gr. xv-xl), Trional (D. gr. xv-xl), the Bromides, Chloral, Paraldehyde (D. M. xxx-ʒij), Cannabin Tannate (D. gr. ij-x), Methylal.

Q. Please state the source of Oil of Cloves.

A. Obtained from the unexpanded flower of the Eugenia Aromaticus.

Q. Can you tell us the section of country from which this plant is obtained chiefly?

A. From the East and West Indies.

Q. From what source is Beechwood Creosote obtained?

A. It is obtained from the destructive distillation of Beechwood.

Q. Are these agents useful in the treatment of any systemic disorders?

A. They are: Oil of Cloves is useful as a carminative (D. M. j-iv); Creosote is useful in the treatment of phthisis, chronic bronchitis and reflex vomiting (D. M. j-iij).

Q. These two agents belong to what division of the essential oils?

A. Sedatives.

PROF. PECK'S EIGHTH LECTURE.

Pathology and Classification of Pulpless Teeth Without Regard to Abscessed Conditions.

Copyrighted 1901.

It is my purpose to present the various pathological conditions leading up to the death of the pulp, and to discuss the meaning of various expressions used in considering cases of pulpless teeth; also to consider them in classes, as based upon the various pathological conditions present in different cases; also to consider the principles of their treatment, or the various therapeutic actions of drugs as made necessary by the different pathological conditions that may be present, rather than to discuss in detail the uses of medicines in their treatment.

The first pathological condition leading up to the death of a pulp is *irritation.* Irritation may be induced by causes, the number and nature of which are many. It is not necessary for me to enumerate them. But this irritation can only be transmitted to the pulp itself through the medium of one channel, and that is the "fibrils of Tomes," except in those cases where caries extends to and exposes the pulp to direct contact with irritating substances from without, in which cases there has been no previous manifestation of irritation, and which class of cases is of rare occurrence.

The walls of the pulp chamber are lined throughout their entire surfaces with a layer of columnar cells—called *odontoblasts.* From the odontoblasts extend fibrils—organic material, in vital structure like the cells themselves, which are called the "fibrils of Tomes," as above referred to. These fibrils occupy space throughout the central portions of the dentinal tubules. It will not be out of place here to consider the fact and to explain why dentine is sensitive, for many seem unable to understand why it should be so, since the tissue contains no nerves. I may, perhaps, best illustrate this point by referring to the nature and peculiar characteristics of the cells called *amoeba.* The amœboid cells are the lowest form of animal life that we know anything about.

While they do not possess the attributes and characteristics in a large measure of regularly organized animal life, some of them they do possess, and one is their sensitivity. These cells are very sensitive to any changes taking place about them. You place them on a glass and observe them under the microscope, and it will be seen that any little jar to the table irritates them, and they immediately draw themselves up into little balls and thus remain motionless, if not further disturbed, until seemingly the danger has passed, when they will begin to move about again. These cells are merely minute particles of vital matter, of protoplasm. So are the fibrils of Tomes composed only of vital matter. As the amœboid cells are sensitive, so are the cells of the human system sensitive. They seem to be constantly on the watch for any interference with the performance of their normal functions, and this disturbance irritates them, the iritation is thus transmitted to the network system of nerves throughout the body, and in turn by the nerve system to the sensorium. It is the same with the dentine tissue. When the dentine is being cut the fibrils of Tomes are being cut, and the irritation thus imparted is transmitted by them to the odontoblasts (which are in close physiological relation with the pulp proper), and by the odontoblasts to the pulp, and by the pulp to the sensorium. In this way the dentine is sensitive; not sensitive in the physical sense or in the literal sense of the word, because there are no nerves in it, but is sensitive in the physiological sense of the term.

Following irritation of the pulp hyperæmia develops. In many cases the pulps die while in this pathologic state, by infarction—the cutting off of the circulation by an embolus. If death does not occur in this way true inflammation follows, during which process the pulp undergoes all the pathological changes and conditions manifested generally in parts while passing through the inflammatory state, with the one exception it does not swell; it is incased in bony walls and cannot swell. In inflammation the normal structural characteristics of the tissue are almost completely lost, so great are the changes that occur. Some portions of the blood vessels are widely distended, while other portions are much contracted; the areolar tissue is filled with the inflammatory products; the cells change form, their spindle-like projections disappear and they become rounded, after which their number is largely augmented by subdivision; the circulation is cut off and the pulp dies. The dead tissue may remain thus indefinitely without causing trouble; not until it is infected with micro-organisms will putrefaction occur. This accounts for the fact that some teeth, containing dead pulps, remain for years without causing trouble. No doubt, in the majority of cases the micro-organisms gain direct access to the pulp chamber through external openings, such as carious cavities; when not in this way, they are carried by the circulation of the blood and enter the pulp chamber through the foraminal opening in the apex of the root. Do not form the idea that micro-organisms are always present in human blood, for this is not the case. Indeed, at the present time it is the teaching of pathologists generally that micro-organisms are not present in normal human blood except by accident. If by any abrasion of the surface of the skin they are permitted to enter the circulation, and while traversing the system through this medium are not brought in contact with an inflamed area at any point, or with an otherwise favorable field for their development, they are destroyed and done away with. They cannot retain their virulency for any length of time, being carried about in the blood current.

When the proper class of micro-organisms is brought in contact with the dead pulp tissue under favorable conditions the process of putrefaction is inaugurated; various gases, according to the different elements present, are generated, and the entire mass of dead tissue is transformed into what is properly termed infectious material, which simply means, in this connection, material that contains the necessary elements to infect, or to cause to become diseased, tissue otherwise healthy. How frequently we hear this tissue in this condition referred to as "septic" material. Many use the two terms—"septic" and "infectious"—as having like meaning. In the early times, comparatively speaking, before any possessed knowledge of micro-organisms, all these pathological conditions of dead matter were referred to as septic. However, after the dissemination of knowledge regarding micro-organisms and their influence in producing disease, the word "infectious" came into general use for reference to dead matter that had been invaded with micro-organisms, or, in other words, that possessed the necessary element to enable it to transmit disease to otherwise healthy tissue. The term "septic" was thenceforth used in a restricted sense. Permit me to illustrate. A felon occurs on one's finger, or a boil any place on the hand or arm; pus micro-organisms are present and pus formation takes place. In order for other tissue to be infected by this pathological condition, it is necessary that a portion of the liquid—the pus—or the micro-organisms themselves shall be brought in contact with it. But there are other elements being continually formed—ptomaines, waste products, which, within themselves, contain no micro-organisms. The human economy is constantly endeavoring to rid the system of these elements. They are carried away from the suppurative process through the channels of the lymphatic system of vessels. The lymphatic glands at the elbow, or more especially at the axilla, become inflamed, sore and swollen as a result of the poisonous waste material passing through them. This material, however, does not possess living germs, so that suppuration will not occur in the glands unless the infecting element—micro-organisms—is brought in contact with them through some other channel. This is "septic" material, and thus, in this restricted sense, should the term "septic" be used at the present time.

So many seem also to have a misconception of, or, perhaps better said, are careless in the proper use of the terms "antiseptic," "disinfectant" and "germicide," that I trust it will not be considered out of place if we give this brief attention. This phase of the subject also carries us back to prehistoric times, so far as micro-organisms are concerned. Up to the time that pathogenic micro-organisms and their connection with disease was understood, the term "germicide" was not in use. "Antiseptic" and "disinfectant" were the only expressions in use in this connection. The word "antiseptic" was used with reference only to those medicinal agents which prevented the decay or the decomposition or putrefaction of the various substances. The word "disinfectant" was used to designate those medicinal agents which would not only prevent the further decomposition of these materials and the formation of gases and mephitic odors, but which would also destroy the noxious properties of fermentation and putrefaction. After a knowledge of the existence of pathogenic micro-organisms was had, and their relation to the causation of disease became familiar, the word "germicide" came into use. This term was used to designate medicinal agents that would not only prevent the decomposition and putrefaction of substances through the agency of micro-organisms, but that would destroy the potency—the life of the germs themselves. In substantially these meanings should these terms be used at the present time.

Antiseptic, as applied to medicinal agents, should be used only in the sense of preventing the development of micro-organisms—preventing putrefaction of nitrogenous substances by holding in check the development of germs. It will be readily understood that all germicides are antiseptics, but that all antiseptics are by no means necessarily germicides.

First let us consider the class of pulpless teeth which seems most favorable for treatment and immediate root-canal filling. Occasionally teeth will present, the pulps of which have died, and in the canals of which no remains of tissue or debris are found. Through some process executed by the mysteries of the human economy the tissue has entirely disappeared. This condition may occur in teeth, in the crowns of which no cavities exist. In these cases the pulps have become irritated from other causes than the poisonous products of carious cavities. They may have suffered shock from a blow more or less severe, or may have been subjected to extreme thermal changes; a low form of irritation is thus inaugurated and continues until eventually the condition of hyperæmia develops, and the pulp dies from infarction without the presence of the inflammatory process.

In the root-canals of these teeth no moisture or odor is found, the walls are dry and clean, seemingly in an aseptic condition. It is the common teaching in these cases, and in the main is no doubt correct, that the apices of the roots have become encysted; a thickened membrane has formed over them, sealing tightly the foraminal openings, thus preventing moisture entering the root-canals from the apical spaces. Comparatively, these cases are not numerous. During my practice I have observed but four of them. It is the teaching of some to make immediate root-canal fillings in all cases belonging to this class of pulpless teeth. I followed this practice in two cases and had no trouble. I think, however, it is better practice to treat with some non-irritating antiseptic a few days previous to filling. One is not positive the canals are aseptic, even though they contain no debris, moisture or odor. A few germs may be present awaiting a favorable opportunity to cause trouble. Remember the old adage, and one more apropos was never uttered, "An ounce of preventive is worth a pound of cure." The use of the stronger agents, as to antiseptic power, is not necessary in these cases, only the milder ones and those, too, which are known to be non-irritating to soft tissues, so the latter, in the apical spaces, will not be irritated as the agents are absorbed by them.

Another class of pulpless teeth that present for treatment is comprised of those in which the pulp tissue remains in the root-canals, and which apparently has not been infected with pathogenic micro-organisms. There is no indication of putrefaction, such as the generation of odors, and the tissues in the apical spaces are not irritated. It is also always best to exercise due caution in the treatment of these cases. There is the same uncertainty as to the actual condition of the contents of the canals of these teeth as attaches to those of the first class. One is not positive that no pathogenic micro-organisms are present, and in most cases will find it better practice to fall a little short of a complete removal of the debris at the first sitting. A non-irritating antiseptic should be placed in the canals for a few days, after which thorough cleansing may be effected. By proceeding in this way the chances of disturbing the tissues in the apical spaces, resulting in future trouble, are reduced to the minimum. I would not say it is impossible to cleanse and make immediate fillings in the root-canals of such teeth with no trouble resulting. No doubt we have all made immediate operations in these cases and have been successful. However, because of the uncertainty of the conditions, I prefer in most cases to treat a few days previous to filling.

Another class of pulpless teeth that presents for treatment comprises those, the tissue in the root-canals of which has been infected with pathogenic micro-organisms. The process of decomposition has been inaugurated and odors are being generated. There is as yet, however, no irritation of the tissues in the apical spaces. This is a class of cases in which no operator, in my judgment, is justified in attempting a complete removal of the contents of the root-canals at the first sitting, to say nothing of the advisability of making immediate root-canal fillings. No matter how expert one may be in the use of broaches or how careful to prosecute the cleansing process under aseptic precautions, the possibility, and in most cases the probability, exists of forcing a quantity, however minute, of the infectious material through the foraminal openings, and thus infecting the tissues in the apical spaces. A complete removal of the contents of the root-canals of these teeth should not be attempted at the first sitting, and the broaches should be carefully used with a firm grasp to prevent them from slipping and forcing the infectious material through the foraminal openings. After the debris has been removed for two-thirds or three-fourths the distance to the apices of the roots, the case should be treated for a few days with a non-irritating agent that is known to be a potent germicide as well as an antiseptic. After this the remaining debris may be removed with little or no danger of irritating the apical tissues.

Another class of pulpless teeth, and the last one I will consider, comprises all cases, the pulp tissue of which has been infected with pathogenic micro-organisms, and the tissue is in the advanced stages of the putrefactive process. Mephitic odors are present to a degree which is decidedly unpleasant. The apical tissues have been infected and are inflamed. The inflammation has extended to other portions of the peridental membrane, and thus general pericementitis is present.

In these cases one should not hesitate to completely remove, by mechanical and medicinal means, the contents of the root-canals. This should be done carefully, but thoroughly. If a portion of the infectious material should be forced through the foramen no special harm is likely to result, in most cases, for the apical tissues are already infected. However, one should exercise judgment in this connection, also due care, because abscesses have been known to develop in a surprisingly short time after the cleansing process has been commenced. All the elements necessary to pus formation are probably present, and when disturbed the process of fermentation is inaugurated and an abscess is the result. This probable termination makes it necessary that extreme care be exercised in removing the contents of the root-canals.

The medicines used in these cases should not only be potent antiseptics, but should be germicides as well. Micro-organisms are known to be present and it is not only necessary that they be restrained from developing, but that they be destroyed. These agents should not only be non-irritating to soft tissue, but should be those the therapeutic action of which is that of sedatives. The apical tissues are inflamed and if irritating agents are used they serve to further aggravate these pathological conditions. If sedative agents are used they will impart to the inflamed apical tissues a soothing influence, will serve to reduce the inflammation, and thus assist materially in one's efforts to restore the tissues to their normal condition. Agents for the treatment of these cases should also possess the properties of deodorants. In cases of long standing the dentinal tubules will be saturated with mephitic odors and gases, and it is necessary that these be destroyed.

In most cases of this class local external treatment is desirable, and even necessary. In addition to the peridental membrane, the gum tissue is inflamed and swollen. The patient may be suffering with constant pain; at any rate, severe pain is occasioned by the slightest pressure upon the tooth. Under these conditions counter-irritation is always indicated. The free local use of appropriate antiphlogistics should not be neglected. Astringents also are of value in assisting to reduce the swelling. Frequently systemic treatment in a moderate degree is desirable and productive of good results. In this connection the chief indications in these cases are to slow the blood current, to quiet the nervous system, and to stimulate the secretions and excretions. This may be done by the use of tincture of aconite and veratrum viride, minim doses every half hour, and tincture of gelsemium, one-half minim doses every hour, till six minims have been taken. Antikamnia, a proprietary compound, which acts on all parts of the system as a sedative, given in five-grain tablets every half hour until five or six of the tablets have been taken, usually results in much benefit. Sulphide of calcium is generally a useful agent in this connection, in doses of gr. 1-10 to ½. If the patient is constipated a laxative is indicated—a saline cathartic—and this should never be overlooked. A hot foot bath just before retiring is helpful, and if the patient is still suffering pain and is especially nervous, nothing is better than the action of Dover's powder on retiring.

The above form of systemic treatment is of special value in cases of threatened formation of abscess, and especially in cases which have advanced to a stage where it seems impossible to prevent pus formation. By this treatment the patient will be greatly relieved, in most cases, from the pain he would otherwise suffer, even though pus continues to form.

PROF. PECK'S NINTH LECTURE.

Pathology, Chemistry and Therapeutics of Putrescent Pulps.

Copyrighted 1901.

In considering this subject in a systematic way we would first naturally wish to know what constitutes a state of putrescence; what changes in the parts involved are necessary that this condition may be brought about; and what elements, if such we may term them, are evolved and necessary to be destroyed. By consulting various authors to find a satisfactory definition of this condition a variety of opinions will be found; some asserting positively this or that, others so framing their statement that more or less doubt and uncertainty is indicated. We find in Dunglison's Medical Dictionary a more complete and reasonable definition than in any other. He says *putrefaction* is "The decomposition experienced by animal substances when deprived of life and placed under special circumstances. Such change is now in the light of modern research considered as resulting from the action of saprophytic micro-organisms. Presence of water is indispensable; the temperature most favorable to it is from 60 to 90 degrees F. The most common products of putrefaction are water, carbonic acid, acetic acid, ammonia, carburetted hydrogen, and a semi-putrid substance which is volatilized and has an infected odor. State of becoming putrid."

No one denies that the old "chemical theory," if such I may term it, of putrefaction has passed from us never to return. All modern authors on pathological matters are agreed that after nitrogenous matter has been deprived of its blood supply, its vitality taken away, thus being changed to a state of gangrene, it must be invaded with micro-organisms before the putrefactive process may be inaugurated.

From my experimental work I find it exceedingly difficult, perhaps impossible, to definitely determine just what are the principal gases and various other products necessary to be destroyed, and that cause us most trouble when we come to apply our therapeutics.

Chemistry of Pulpless Teeth.

The statement that "hydrogen sulphid is the chief gas evolved" in putrescent pulps has generally been accepted as correct. The first of my experimental work seemed to verify that statement, but later I found it to be incorrect. Indeed, one who studies the process of decomposition of nitrogenous matter carefully, and from a chemical standpoint, must conclude that the exact nature of these products of decomposition which yield odor cannot be definitely determined. It has heretofore been generally stated by dentists that the odor from putrescent pulps is due to the presence of *hydrogen sulphid.* When nitrogenous matter, as for example egg albumen, contains *sulphur,* hydrogen sulphid is undoubtedly a final product of the process of decomposition, and in part must be responsible for the odor evolved. I say in part, because these nitrogenous substances containing sulphur have been treated in various ways, in connection with the putrefactive process, and I have not been able to produce any such odor as sometimes emanates from the pulp-chamber of a tooth.

It is true that the human system contains more or less sulphur, and is the supposition an unreasonable one that dead pulps of teeth contain this element, although it may be present in minute quantities? This granted, are we warranted in attributing all the odor encountered in some cases to the evolution of hydrogen sulphid from the necessarily small quantity of sulphur present? Or is the supposition a reasonable one, that from a union of various other elements that are present, or products that are being evolved, there is generated another odorous substance, other than hydrogen sulphid, but the distinguishing characteristics of which in no essential particular differ? I do not feel warranted in making this statement as fact, but from the work accomplished thus far it would seem to be so.

Perhaps from a purely practical standpoint it is not necessary that we understand these things. However, he who would treat these cases intelligently and from a scientific standpoint should seek as complete a knowledge of these conditions as possible, so that knowing the varied therapeutic value of his medicinal agents he may be able to apply those that are best calculated to destroy these obnoxious products of the putrefactive process.

Again, from a careful chemical study of this process, it will be found that ammonia (NH_3) is in all probability the chief final gaseous product, but it is the opinion of the chemists that this has little to do in the formation of the foul odors. I have also determined that *water*, *oxids* of *nitrogen* and even *free nitrogen*, and most important among these, *carbonic acid gas*, are prominent among the final products of decomposition.

The foregoing are undoubtedly the principal elements, both pathological and chemical, that are naturally found in connection with putrescent pulps, but these are not all. We are forcibly reminded of this fact when we stop to consider that discolored teeth nearly always have previously contained putrescent pulps, or those in connection with which abscesses have formed. We are also familiar with the fact that chemical elements other than those already enumerated are in all probability present; and further, the all-important fact that they are continually uniting, only to lose their individual identity; and as a result of these chemical unions certain other elements of an entirely different nature are produced which are directly responsible for the production of other undesirable results.

Of all the metals iron is no doubt most intimately disseminated throughout the system. An excess of iron may be present in the blood of an individual, and if so the pulps of the teeth will contain their proportionate excess of the metal in the red blood corpuscles. It is the opinion of chemists that an "excess" of the metal in the system is not necessary in order that the following chemical action may take place. In case of putrescent pulp the red blood corpuscles are broken up and the iron is set free. This unites with the hydrogen sulphid present, and sulphid of iron is the result of this chemical union. Reflect on the number of discolored teeth that come under our observation, in which it seems certain that the discoloration is effected by some salt of iron.

Is it not a reasonable statement, that in individuals who are suffering from ptyalism, systemic poisoning by mercury, more or less of this metal finds its way into the pulps of teeth and unites with a portion of the hydrogen sulphid, the result being the formation of *sulphid* of *mercury?* There may be an excess of manganese in the system, or of lead or other poisonous metals, in which case the *sulphid* of the respective metals may be found in the decaying pulps. Thus it will be seen there are many elements to be considered and to be gotten rid of in the treatment of putrescent pulps, other than micro-organisms and their poisonous products.

Putrescent pulps of teeth of individuals who were suffering with ptyalism and others with plumbism have been subjected to proper chemical tests, with the idea of revealing the presence of these metals and their sulphids. While this work is exceedingly delicate, and I must confess for the most part unsatisfactory, as regards the two metals last named, sufficient has, however, been determined to warrant the statement above made regarding these chemical actions and the formation of these sulphids. As regards the presence of iron and its sulphids there is no doubt left.

Therapeutics of Pulpless Teeth.

Before proceeding with the therapeutics of these cases let us consider some of the seemingly mysterious happenings under certain conditions with putrescent pulps. The fact that pulps die in some teeth and lie dormant for months and even years without causing trouble; and the further fact that the moment the pulp-chamber is opened, thus admitting air and saliva, there is inaugurated an activity that is certainly surprising and seemingly unwarranted, are of interest to us. I have seen cases in practice where seemingly all the processes and changes, both pathological and chemical, incident to putrefying pulps have been inaugurated almost instantly on opening into the pulp-chambers, and notwithstanding that the utmost care has been used in the treatment of them severe apical pericementitis has been caused, and in rare instances even abscesses have resulted. There must be a reason for this, otherwise these cases should yield nicely to treatment as many others do. I have tried to solve this question by adding *fact* to our present theory, but frankly confess that I have been able to accomplish little.

There are many classes of micro-organisms that lie dormant, that do not excite fermentation in the absence of oxygen; hence the inactivity of those elements before air is admitted into the pulp-chambers. The moment air passes in, however, the oxygen necessary to arouse to activity these hitherto dormant elements is imparted to them, the varying degrees of activity thus induced being dependent upon the susceptibility and character of the elements present. The fact that with careless operators other micro-organisms of perhaps a more virulent and active nature are admitted with the saliva must be a potent factor in causing the rapid and severe changes that occur. In the light of our present knowledge the above explanation seems the rational one for the overactivity of those cases as described, but I believe there is opportunity for further enlightenment on this point.

The fact that the crowns of many teeth containing dead pulps, and hitherto not discolored to any appreciable extent, on being opened into, thus permitting saliva and air to come in contact with the decaying tissue, do discolor excessively in a very short time, is not an infrequent source of much wonder and humiliation. For example, a patient presents with a tooth containing a dead pulp that is causing trouble. The dentist is occupied with other work and cannot take the necessary time to make proper treatment. He simply opens into the canal, that the gases which are being generated may escape, thus affording relief to the patient. As stated above, the tooth at this time is not discolored. The patient is dismissed with instructions to return the next day or the day following, when proper attention will be given to the case. At the second sitting it is observed that the tooth is discolored very much, this change having taken place within a very short time. What is the explanation?

It is the same line of reasoning as in connection with the overactivity of the micro-organisms in these cases. The various processes incident to putrefaction are intensified when saliva and air are brought in contact with the decaying mass. This seems especially true of those changes or processes which result in the formation of the coloring materials. The reaction, caused by a union especially of the hydrogen sulphid and the oxygenated hemoglobin of the blood, is intensified, thus resulting in the formation of perhaps the chief coloring material, called sulphomethemoglobin, in much less time and in larger quantities than when oxygen is not admitted. The dentinal tubules become saturated with this and other coloring materials, the formation of which is thus unduly brought about. In therapeutic applications to these cases such occurrences must be avoided. He who permits an undiscolored tooth containing a dead pulp to become discolored to any extent after treatment is commenced is certainly deserving of censure in the majority of cases. After treatment is begun no foreign substances or even medicines should be permitted in contact with the tooth structure or the contents of the pulp-chambers, except those that are needed to best subserve the interests of the treatment, and that are placed there by the dentist himself. We cannot have impressed upon our minds too strongly the importance of extreme care in this regard.

From all this you will readily appreciate the force of the statement that if we would treat these cases intelligently and scientifically, it is not enough that we simply use a good germicide and deodorant. We must be familiar with the various properties of the medicinal agents to be used and understand their power of destroying the many different elements present in this condition. I would that we could all be first-class chemists, both analytical and synthetical, for then we could subject our medicines to the necessary tests and analyses to determine whether or not they are best suited to successfully combat the various conditions, both pathological and chemical, to which they are being applied, and failing in this, we might be able to compound a remedy that would better subserve the purpose to which it is put. If we have a clear understanding of the various compounds that must be destroyed, and also in a general way of the peculiar properties of the medicines to be used that render them suitable agents to be applied to these various conditions, we are able to treat them intelligently, and with a reasonable degree of assurance of favorable results.

There can be no doubt that in the therapeutics of putrescent pulps those medicinal agents that contain *oxygen* as one of their principal elements, and which are easily broken up, thus freeing the oxygen or a portion of it, are most effective. We must remember that this element, oxygen, when in proper combination is one of the best agents that we have for the treatment of such conditions as obtain in putrescent pulps, and is one of the best germicides, deodorants and bleachers—the three principal properties to be possessed by medicines used in these cases. For the reasons cited above I have always contended that the conservative use of such agents as peroxid of hydrogen, hydrozone and pyrozone constitutes a form of treatment which cannot be excelled for thorough cleansing. I would, however, advise operators to be very careful in their use of these agents in pulp-canals, and especially that they be careful to secure a full free opening for the exit of the gas evolved, for if the exit be in any way obstructed it will press through the apical foramen and perhaps carry poisonous material before it to the soft tissues of the apical space, causing trouble.

There is an unlimited number of agents containing oxygen that might be used in these cases, but it must be remembered that only those which readily liberate oxygen at ordinary temperatures, that is, those which contain available oxygen, are effective. Water (H_2O), for example, contains oxygen, but it is not an active oxidizing agent, because the affinity between the hydrogen and oxygen is so strong that the latter is not readily liberated under ordinary conditions, as is the case with peroxid of hydrogen (H_2O_2) and the other agents belonging to the same group. In these compounds the combination is very unstable, and they readily break up into H_2O+O, and this nascent O, thus liberated, brings about the strong oxidizing action characteristic of these agents.

Potassium permanganate, with a chemical formula of $K\,Mn\,O_4$, in proper solution, is a valuable agent in the treatment of these cases. Nascent O is readily liberated and enters into combination with the various products of the putrefactive process, and by oxidation destroys them. As a deodorant it is one of the best agents we have. We may truthfully say that *nascent oxygen* is the only great chemical purifier. Indeed, this is nature's method of getting rid of such objectionable conditions as these under consideration.

In a previous publication I am made to say that "no medicines should be used in these cases and remain any length of time, until the contents of the pulp-canals have been as carefully and thoroughly removed as possible by mechanical means." There is some probability that this statement may be misunderstood. I do not mean it should be our aim to completely remove the putrescent material from the pulp-canals at the first sitting—perhaps some of us are familiar with the extreme ease with which poisonous material is forced through the apical foramen, causing abscesses to develop. What I mean is, that after a portion of the putrescent material has been removed, the medicinal agent placed in the canal should not be permitted to stay more than two or three days before the remainder is carefully but thoroughly removed. If permitted to remain too long discoloration is probable, and not infrequently occurs as a result of the action of the medicine and the various elements contained in the putrefactive mass.

There is an agent to be used especially as a deodorant about which we hear little, but it is one which I use with so much satisfaction that I deem it worthy of mention. It is meditrina. This is only purified sea water charged with electricity, and while a fairly good antiseptic it is not so potent as has been claimed. Just how meditrina acts as a deodorant I have not by experimentation been able to definitely determine. I think, however, there is no doubt that its virtue in this connection is largely due to the nascent chlorin evolved by it. It is claimed that it enters chemically into combination with the mephitic odors and gases, and in this way effects their destruction.

In the general treatment of these cases our thoughts most naturally revert to a consideration of the *essential oils*. That we may intelligently use these agents it is not sufficient that we understand only their value as antiseptics and germicides and their therapeutics as regards soft tissue; we must study them with a view of determining what other properties or elementary constituents they possess that render them useful in destroying the various products of the putrefactive process, as well as the micro-organisms and their poisonous products. A study of these oils from a chemical standpoint is a very delicate matter and unsatisfactory in a large degree, as it is difficult to definitely determine facts.

From the U. S. P. we obtain a partial classification, and I have been able to determine some things in addition. Putting them all together, I am pleased to present the following classification: First, those composed of hydrocarbons only, as oils consisting chiefly of terpenes ($C_{14}H_{6}$), such as oil of turpentine, of lemon and of camphor. Second, those containing hydrocarbons mixed with oxygenated products, as oils consisting chiefly of cedrenes ($C_{15}H_{24}$), such as oil of cedar, of cubebs and of cloves. Third, oils consisting chiefly of aromatic aldehyds and allied bodies, such as oil of bitter almonds and of cinnamon. Fourth, oils consisting chiefly of ethereal salts. These may be either (a) oxygen salts, as in wintergreen or (b) sulphur salts, as in oil of mustard and of garlic.

The first division, or terpenes, being allied to the hydrocarbons, are those composed chiefly of hydrogen and carbon. The second division, or cedrenes, mean a volatile liquid hydrocarbon found in the oils of this division. They also possess a camphor which is deposited, the formula of which is $C_{15}H_{26}O$. Thus the benefit of the action of the element oxygen is obtained. You will observe that oil of cloves, one of our most useful agents, belongs to this class. The third division, or those consisting of aromatic aldehyds, mean the presence of aroma in a class of compounds intermediate between alcohols and acids, derived from their corresponding primary alcohols by the oxidation and removal of two atoms of hydrogen, and converted into acids by the addition of an atom of oxygen. Oils of cinnamon and cassia belong to this division. Is not this fact that they partake largely of the nature of acids, a just explanation of their extremely irritating properties manifested when applied to soft tissue? In the fourth division, or those containing ethereal salts, we find oxygen is one of their elementary constituents, as the formula of ether is $(C_2H_5)\ O_2$. The oils of this division that are of sulphur salts, and which are proper to be used in the treatment of these cases, may be employed to excellent advantage after the general debris of the putrefactive process has been thoroughly removed from the canals, as there is evolved from them a product of the sulphur series, which in combination with water forms an excellent bleaching and disinfecting agent.

Whether we are justified in stating, from a purely chemical and scientific standpoint, that special value should be attached to the use of these oils that belong to the oxygen series is a question. I have been unable to demonstrate one point which I had hoped to do, and that is that the oxygen is liberated from the combination, thus furnishing nascent oxygen for action. However, from a practical and clinical standpoint, the special value of this series of oils in the treatment of putrescent pulps cannot be denied.

Some two years ago I obtained a sample of the first lot of synthetic oil of cinnamon received in this country. On experimenting with it in various ways, I was much impressed with the activity it exhibited in producing results. This was especially noticeable in its action on soft tissue. Its irritating properties were manifested in less time, and at first in a more vigorous manner than was the case with the natural oils. I then remarked that this difference in action must be due to the fact that it is a made oil, and that the union between the atoms of the various elements of which it is composed is relatively unstable, so that the compound is readily broken up, thus setting free the various elements and enabling them to act independently and more rapidly in producing results. Possibly, in the not far distant future, some of the most available and potent antiseptics, germicides and deodorants may come to us from the laboratory of the chemist in the form of synthetic preparations.

TENTH LECTURE.

Abscess.

Preliminary to this subject I will read a portion of a paper written by myself some three or four years ago, which will stand as an introduction to the various pathological conditions connected with the various parts involved in the formation of an abscess:

"An abscess is a collection of pus in the tissues, says an eminent pathologist, the formation of which is always preceded by a circumscribed suppurative inflammation, whereas, the accumulation of pus in a preformed space, such as the pleura, pericardium, pelvis of kidneys, etc., although resulting from a suppurative inflammation of the walls lining the space, is not by general custom and usage called an abscess, but the presence of pus in any of these organs is indicated by the prefix *pyo*, a Greek word, which, in combination with the name of the anatomical locality, signifies connection with, or relation to pus—thus *pyo-thorax*, *pyo-pericardium* and *pyonephrosis*, respectively.

"The histological conditions present at the time of the commencement of pus formation are characterized by a richness of leucocytes in the connective tissue between the inflamed capillary vessels and the compression of the pre-existing tissue cells by them and the transuded serum.

"Thus, it is at once apparent that before an abscess can be formed, the affected area must pass through all the stages of the inflammatory process, a discussion which, in this paper, time will not permit.

"Says Dr. Black, abscess is the result of a severe but circumscribed inflammation, which causes the destruction of a certain area of tissue; or leucocytes may collect in large numbers at the center of the focus of the inflammatory process, and, being reduced to a very low state of vitality, become aggregated together, and cause a separation of the tissues, thus forming a *pus cavity*. Tissue, to a greater or less extent, being destroyed in the focus of the inflammation, and becoming dissolved, or being formed into small gangrenous masses, mingles with the fluid and corpuscular exudates to augment the volume of pus.

"Simultaneously with this action is the tissue in the immediate vicinity being infiltrated by the exudation of coagulable lymph, thus forming the so-called abscess wall, beyond the limits of which infection does not extend.

"There is one positively essential element to the formation of pus not yet mentioned, and that is the presence of pus microbes; the *staphylococcus* almost invariably being found in circumscribed abscesses, while the *streptococcus* variety is more prone to cause diffuse purulent infiltration of the tissues. These germs may be brought in contact with the affected part from external sources; but more frequently this is accomplished through the medium of the circulation of the blood and the lymphatic system. How many of us have stopped to consider all that is taking place or has taken place within the tissues, when, on opening a tooth, we find just a globule of pus in the space formerly occupied by a single horn of the pulp, that the affected part has undergone all the pathological conditions attendant upon the formation of the largest abscess that has ever, or may ever, invade any part of the human organism?

"Abscesses are classed as acute and chronic, according to the character of their discharge, causes, and the time which elapsed between the commencement of the disease which caused them, and their formation.

"An acute abscess is the usual result or termination of acute circumscribed suppurative inflammation, and contains the characteristic yellowish, creamy pus. It occurs within a very few days after the commencement of the inflammation, and reaches its maximum size in a short time.

"The chronic variety, generally speaking, is usually traceable to some specific chronic inflammation, generally of a tubercular nature. As we apply the phrase in dentistry, it means an abscess of long standing; one which has become complicated with other troubles, which do not yield readily to treatment, such as the accumulation of serumal deposits, or carious bone, or both. An abscess occurring within the alveolus in no way connected with the teeth should not be referred to as an alveolar abscess. Only that having its origin in the apical space and being dependent upon the death of the tooth's pulp should be termed alveolar abscess."

Hyperemia.

We will now consider minutely the pathology of the parts involved in the formation of alveolar abscess. The first pathological change which takes place in the tissue and which as we shall see is not always necessarily a pathological condition, is that referred to as HYPEREMIA.—First, hyperemia is of two classes, *active* and *passive.* There are two kinds of active hyperemia, *physiological* and *pathological.* That which is called physiological is in no wise dangerous to the future health of the tissues; it invariably passes away and the parts return to their normality. It is the pathological variety with which we are especially concerned. As an illustration of what may constitute active physiological hyperemia may be cited the following. Ordinary blushing is nothing more nor less than a physiological hyperemia. Through the influence of the vaso-motor system of nerves which control the muscular walls of the vessels, the small arteries are caused to dilate and a large quantity of blood is thus carried to the part, which readily passes away. Another illustration of physiological hyperemia is this, and one which no doubt you have all experienced, especially upon reaching your own homes after having lived for months in the boarding houses of Chicago (laughter). You go home and see an excellent meal prepared and set on the table before you. The salivary glands at once become active, more so than normal, because of an increased blood supply; a larger quantity of saliva than normal is poured by them into the mouth; the mouth waters, active physiological hyperemia of the salivary glands, which readily passes away as the good things disappear.

Active hyperemia simply means a greater influx than normal of blood to the part, which passes readily through the part, which does not accumulate in the part involved, but through the influence of the vaso-motor system of nerves the small arteries are dilated and thus a larger quantity than normal of arterial blood passes through the part involved. The veins in active hyperemia remain in a healthy normal working condition, so that this blood that is thus brought to the part in large quantities is carried away as rapidly as it comes. This, briefly stated, is what constitutes active hyperemia.

blood continued to flow, these elements continued to pass into the tissue, the swelling continued to increase until the part presented the appearance of a genuine blood clot, and to all intents and purposes, practically speaking, constituted a blood clot, which was kept intact through the medium of the tissues. These tissues die in this condition, necessarily so, and this is the condition called infarction.

Do not get an idea now that all conditions of hyperemia result in this way. From what I have said, were I to pass on and say no more on this point, it would be perfectly rational for you to form the ideas that all hyperemias result in infarction, in a death of the tissue. But not so; for a great many of these forms of hyperemia, even pathological, are amenable to proper treatment and the parts return readily to their normal condition. Especially is this true in dealing with the pulps of teeth, and I want you to remember all that we have said thus far in connection with this pathological condition, because we shall refer to it when we consider the pathology, diseases, treatment, etc., of the dental pulp. The pulps are especially liable to this form of disease, and in every way it is of much more importance in connection with this organ than any other in the system. And it is necessary that you understand it thoroughly, for, as Dr. Black has said, I say in substance this morning, that if there be any profession engaged in the merciful vocation—the healing art—that ought to understand thoroughly, in all its phases and details, this pathological condition, hyperemia, it is the dental profession. And when we take up the subject of inflammation I caution you to follow this process carefully that we shall be able to distinguish the characteristic features of hyperemia as in contradistinction to those of inflammation.

With regard to the swelling connected with hyperemia, which is caused by the exudation of the watery portion of the blood in the surrounding parts. This swelling, in connection with this process of hyperemia—not inflammation—is what is called edema. This liquid portion of the blood is entirely different in character from the liquid exudate which is one of the chief characteristics of the inflammatory process, as we shall see later on, which passes into the tissue and is responsible, very largely, for the swelling in connection with inflammation. This liquid portion of the blood in hyperemia which passes into the surrounding parts is not coagulable to any great extent, and does not coagulate in the tissues. It does not become hard; it remains more in its normal liquid state, so that in the swelling connected with hyperemia, you press upon it with your finger and a dent remains in the tissue for some little time after the finger is removed. This watery substance is pressed laterally away from the part upon which the pressure is immediately exerted, and it takes it some time to return. This forms the chief clinical difference in the diagnosis of the swelling of hyperemia and inflammation proper.

Inflammation.

I presume you have had this pathological condition, inflammation, in your general pathology, so it will only be necessary for me to refer, in order to freshen your minds, more particularly to the essential points connected with it.

In order to study thoroughly and conveniently the process of inflammation, any thin membrane that is easily placed under the field of the microscope and easily retained there, where the circulation of the blood is passing normally through the parts, may be used. The web of the frog's foot may be used to excellent advantage for this purpose. The web of the frog's foot is stretched and fastened over the field of the microscope for observation; then take some irritant, more or less powerful, and apply a little to this membrane. The first change that is observed in this process is a slight narrowing or contraction of the small arteries in the part. This, however, obtains but for a short period of time; the contraction in most instances is slight and passes away very quickly, so that some investigators on this subject deny absolutely that this occurrence does take place. But we have it from one of the greatest pathologists in this work that it does occur, that he has observed it in his experiments many, many times—Dr. Black. (Applause.) After the contraction of the walls of the vessel passes away, the artery becomes enlarged, dilated, and the flow of blood at the very outset becomes quickened, accelerated, passing more rapidly through the part involved. This, to all appearances, is a simple active hyperemia—the hyperemia of irritation that always precedes the inflammatory process. After this persists for a time the blood streams become slower in their movement. The red blood corpuscles occupy for the most part the central portion of the blood stream, while the leucocytes, or white blood corpuscles, occupy the circumference of the blood stream, passing along near the inner walls of the blood vessels, and after a time we notice these white blood corpuscles seemingly to develop a quality of stickiness, so to speak, because they begin to adhere to the inner walls of the blood vessels. Some of them will cling there for an instant, then break away under pressure of the blood current and pass on with it. Others will adhere to the walls of the vessels, and as the pathological condition progresses these corpuscles become thickly studded all about the inner wall of the vessel and begin to pile one upon the other; the blood current becomes slower; the red globules also turn aside and cling to the walls with the white, until the vessel is clogged. The blood current is stopped, the blood is prevented by this means from passing through the vessel. This condition is called *stasis.*

But before the condition of stasis develops there is another condition which takes place—the *diapedesis,* or the passage of the leucocytes through the walls of the vessels into the surrounding tissue, and they begin to pass out very considerably. The process by which they pass through the wall of the vessel is an ameboid movement. A small portion of the leucocyte will be observed to force its way through the wall of the vessel. In a very short time a larger portion of the cell is on the other side of the wall, and thus the entire cell passes through, and they pass through in large numbers. The tissues become thickly studded with them, especially in the neighborhood of the vessels.

ELEVENTH LECTURE.

Inflammation—Concluded.

At the close of the last lecture the tissues were filled up with leucocytes, white blood globules. In connection with the exudation of the white blood globules into the surrounding tissue, the red blood globules also exude to a certain extent, but by no means in such large numbers as the white ones. Not only the corpuscles of the blood pass from the vessels into the surrounding tissues, but also the serous exudations take place to a very great extent; the surrounding tissues become filled with them, and the field in which the inflammatory process is going on becomes so completely filled with these products of the blood, corpuscular and serous, and becomes so cloudy, in consequence, that the further observation of this process of inflammation with the microscope is very much interfered with, so that we cannot with any degree of satisfaction or accuracy follow further the changes that are taking place; certainly not with that degree of accuracy that scientific precision demands.

The exudates that occur in the inflammatory process in the surrounding tissue, as you have already seen, come almost exclusively from the blood itself. Of course, the surrounding tissue contributes more or less, but by far the majority of this infiltration of the soft parts comes from the blood.

The exudates of inflammation are mainly of three varieties, first, the *serous*; second, the *fibrinous;* third, the *corpuscular.* This serous exudation which takes place in connection with inflammation is not, strictly speaking, characteristic of the inflammatory process itself, but is characteristic of the process of hyperemia. And you understand that the process of hyperemia invariably precedes that of inflammation. The first change in the tissues, in the vessel that was observed by use of the microscope, in the web of the frog's foot, after the irritant had been applied to it, was the process of hyperemia, not of inflammation. The arteries became enlarged, the blood flowed through them in larger quantities than normal and at first more rapidly. To all intents and purposes this was simply a hyperemic action, and there was nothing in this process in any of the tissues, or in the vessels, or in the blood itself, that would indicate at first that the process of true inflammation was to follow that of hyperemia, except that we knew this—that an irritant had been applied to the tissue, and that when the tissues are irritated to any considerable extent inflammation nearly always follows the condition of hyperemia. But so far as this exudation, so far as the blood vessels, so far as anything within the field of observation was concerned at this particular moment that we could see, it did not say to us that inflammation was to follow the hyperemia. Not until the leucocytes, the white blood corpuscles, begin to stick to the inner wall of the vessel, do we have any indication that inflammation is to take place. This phenomenon is the first change in this entire process that indicates definitely that inflammation is to occur and that we are to have something more serious taking place in those tissues than the mere process of hyperemia.

I have made the statement that hyperemia always precedes inflammation, which is true. Hyperemia always accompanies the process of inflammation from its very inception to the finish of the process in the parts, or until restitution has taken place, until the wound has healed. We find about the inflammatory center proper an area of more or less extent that is swollen, that is filled with the exudate of hyperemia. The liquid in these tissues causing this swelling is readily removed from the immediate part under pressure of the finger, and after a time it returns again. The swelling is soft, the liquid has not and does not coagulate. You will always find this edematous swelling of hyperemia surrounding the inflammation proper, accompanying the process of inflammation all the way through. However, do not form the idea that in any wise the hyperemic process is the cause of the inflammatory process. Hyperemia is not the cause of inflammation; hyperemia is simply the first change observed in the tissues when inflammation is to take place. This hyperemia at any stage of the process may subside, the tissues return to their normal healthy condition and no inflammation follow. It is simply an accompaniment of the inflammatory process.

The same causes that result in inflammation in the tissues simply induce the process of hyperemia as a preliminary and an accompanying result.

The fibrinous exudate, a substance passing from the blood into the surrounding tissues, is strictly characteristic of the inflammatory process and does not occur in the hyperemic process. This exudate passes from the vessels into the surrounding tissues in liquid form. It holds in solution large quantities of fibrinogen, which, when it passes into the surrounding parts, coagulates, becomes hard, and this hardening of the exudate in the tissues is the first clinical sign that is noticed in the diagnosis of this process as distinguished from the hyperemic process itself. This exudate coagulates, becomes hard and resistant to pressure.

The corpuscular exudates in inflammation we have already covered pretty thoroughly. We might simply say a few words further in regard to the movement of the white blood corpuscles, or leucocytes, after they have passed out of the vessel into the tissue. These corpuscles are continually passing about in the tissue, wandering about. They not only pass into and through the soft parts, but hard substances placed in the tissue they penetrate as well, unless, of course, it is some substance that is impenetrable. But, for instance, a piece of tissue like the cornea of the eye—that is, tough and hard—these leucocytes will penetrate it, pass into it. Also foreign substances of other nature; milk injected into the tissues. They do not pass into this, they rather take it up into themselves, absorb the globules of the milk. And also other substances, such as coloring matter, fine particles of vermilion passed into the circulation; these little cells absorb them, take them up, try to get rid of them. In fact, they are constantly endeavoring to free the tissues of these invading foreign substances; and their chief function at all times, under these circumstances, is to bring about tissue repair.

This inflammatory process gives rise to four conditions, most of which are observed during the inflammatory movement, and may be referred to as the classic signs of inflammation; these are, *heat, redness, swelling, pain.* The last one, pain, being of special importance when we come to consider the diseases of the pulp.

Heat is caused simply because of the presence of a larger quantity of warm blood in the part than is normal. Years ago it was considered by pathologists generally that this rise in temperature in the part involved in the inflammatory process was due very considerably to the more active metamorphosis of the tissues—the changes going on within the inflamed area—due to the oxidation taking place within the tissues; but that theory has been refuted of late very successfully. One experiment that was performed by Conheim for the purpose of determining, if possible, which of these theories was correct, was this: He induced in the leg of a dog a very severe inflammatory process by scalding with hot water. In another leg he induced a process of hyperemia by severing the vaso-motor system of nerves controlling the vessels in that part. The blood returning from each of these pathological fields was carefully examined, and that which returned from the hyperemic leg was found to be slightly warmer, if any difference, than the blood returning from the leg in which inflammation was present. Other experiments, which we will not take time to refer to, have been performed by various investigators for the purpose of settling this point, with the same results. So that we may say to-day, and it is the generally accepted theory, that undue heat in the part involved in inflammation is simply due to the presence of this undue quantity of warm blood, so that the heat of hyperemia or of inflammation never rises above the normal temperature of the blood.

Redness, of course, is simply due to the presence of this large quantity of red blood accumulated in the part. The blood thus reflects its characteristic color to a greater extent than it is reflected when the blood is spread evenly throughout the entire system.

The pain connected with the inflammatory process is due chiefly, first, to the injury of the tissues, which causes the inflammatory process to take place, also by the stretching and compression of the nerves in the tissues through their infiltration with the inflammatory exudates. These exudates pass into the surrounding tissue, the fibrinous portion coagulates and becomes hard, and within that hardened mass are more or less nerve fibrils encompassed. This swelling, and also the swelling in the adjacent parts—that of hyperemia—compresses and stretches these nerve fibrils, and hence the pain. This is a phase of the subject, unfortunately, that we actually know but very little about. However, the pain of different inflammations—resulting from various causes—in the same parts differs a great deal. From this it is logically inferred that the character of the cause of the inflammation has much to do with the nature and extent of the pain. Again, the pain of inflammations occurring in the denser or firmer tissues, is more severe than that connected with inflammations in tissues that are less dense or firm. There have been multitudes of theories advanced by different pathologists on this question of pain in inflammation, but none have been able to make their statements as representing definite results of reliable experimentation. It is a field which is still open for definite knowledge yet to be largely gained. But these factors referred to in the production of pain have been settled, and that is about all that we know about it.

The swelling of the part is due to three different causes: First, the enlargement of the blood vessels; the capillaries especially become very much enlarged, and in tissues where there are many capillary vessels, connecting the small arteries with the small veins, this has a great deal to do in causing the swelling in the part. The swelling, however, is most largely due to the presence in the tissues of the exudates of hyperemia and the exudates of inflammation.

This process of inflammation we might follow and spend several hours considering, and possibly to more or less advantage to us. It is such a wide field that it is difficult to tell just where to leave it in order best to serve our special interests. But, as I said, you no doubt have had this work; if not, you certainly will in your general pathology, so that I will not follow it any further, but work gradually to our special application of it—alveolar abscess.

Suppuration.

A few words on the subject, in a general way, of suppuration, which is to follow this process of inflammation. In former years, before the medical profession was learned in bacteriology, the idea of suppuration, briefly stated, was this: that where the inflammatory process was sufficient, where the destruction of tissue through this process was sufficient, that suppuration resulted as a natural accompaniment of the inflammatory process; that if the inflammation was severe enough suppuration was sure to follow. They knew nothing of the agency of micro-organisms in bringing about suppuration or pus formation. This inflammatory process, you must remember, is not simply a paralysis of the tissues, but it is an overaction of the tissues of the parts involved, and that after this activity had passed a certain point pus formed, which fact these men knew at that time as well as it is known to-day, and upon this fact mainly they based their argument at that time as to the cause of suppuration.

The surgeons at that time watched with very much interest and anxiety the process which they termed the "establishment of secretions," throughout their dealing with any of their surgical operations in which inflammation developed; this "establishment of secretions," or the appearance of the inflammatory exudates, was an item of much moment to them. Not knowing, as we have stated, anything about micro-organisms or their relation to this pathological condition, they reasoned thus: that if these exudates of the inflammatory process took place in a natural normal manner, as they were accustomed to take place in connection with the inflammatory process, and pus formed, they reasoned that it depended entirely upon the character of this pus as to whether their wound was doing well or doing badly. If the process went along naturally, as they were accustomed to see it, and this yellowish pus of creamy consistency formed, which they termed laudible pus, and which they expected and looked for in connection with each and every case, they were happy; they considered that under these conditions their wound was doing just as well as it possibly could and that it would continue to do well, and in the course of time, after the process had run its natural course, as they supposed, the wound would heal without trouble. But, on the other hand, if this process did not move on smoothly, if the pus which formed was thin, purulent, possessing more or less odor, they considered it a very bad omen; they considered that the wound was not progressing as it should and were more or less alarmed in connection with the case, especially if this occurred to any very great extent.

It may be stated that the observations of these men at this time in regard to the inflammatory process in a general way, as regards suppuration, the formation of pus, with regard to the relations of—if we may use the expression—normal pus—the first cited in this case—yellowish, creamy pus—to the healing of the wound, were just as correct as are the ideas of pathologists at the present day. But where they were lame was in the thing that they did not observe, which, mainly, was the factor—micro-organisms.

At that time their knowledge was not extended far enough, their observations were not carried on carefully enough, they did not detect the presence in the pus of micro-organisms in any of their investigations. I don't know that they were especially at fault in this, because we all know that in order to see plainly in specimens, micro-organisms in pus, a special process of staining is necessary to bring them out to view, so that the microscope will reveal their presence. Of this process of staining specimens and their other preparation for examination, at that time they knew nothing. But as time passed on their knowledge became more extended and more definite, and during the few years previous to the year 1869, there was quite an animated discussion being carried on through the medium of the journals, especially between Pasteur and Liebig—two prominent pathologists and investigators—in regard to bacteria and their relation to the cause of disease and pus formation. And Mr. Lister, a surgeon of England, in the year 1869, became very much interested in the debates between these two noted men, and resolved, if possible, to prevent the access of micro-organisms to wounds which he was called upon to treat, because it was claimed, by Pasteur especially, that micro-organisms were found almost everywhere in the atmosphere all about us, and that suppuration in these wounds was caused directly by the presence of these micro-organisms. This was Pasteur's teaching and Mr. Lister came to the conclusion that if this were true, that if micro-organisms were generally present everywhere, that they certainly must have something to do with the extent of the inflammatory process. He did not even conceive the idea at that time of preventing pus formation in wounds which he cared for, even if he succeeded in excluding these germs entirely. He did not believe at this time that they were necessary to pus formation, simply that they might have some influence in carrying on the inflammatory process and making that process greater, more extensive, more destructive of tissue. So he conceived the idea of making his operative wounds in a way that might, if possible, exclude these germs from the wound. I speak of operative wounds, because there is a decided difference in the nature of wounds. When we use the expression operative wound, we mean a wound that is made by a surgeon, in any operation whatever, in which he has control of all the conditions under which the wound is made; and in the light of our present knowledge we can make these wounds, and the surgeons do make them so as to exclude germs from them. Accidental wounds are those which have been caused by an accident, the tissue has been torn, lacerated. Nobody has had control of the conditions under which the wound was made. The debris, the germs and everything of that nature have free access to the wound.

Mr. Lister made his incisions in the soft tissue in an atmosphere of a spray of carbolic acid. His assistant kept the spray of carbolic acid on the tissues and in the air immediately about the parts upon which he was operating, and instead of covering the wound—after he was ready to close it and leave it to itself—with ordinary pieces of cloth which had never been sterilized, he covered it with sterilized cotton and took every precaution possible to prevent the ingress of micro-organisms. The result was that very often these wounds healed without the formation of a particle of pus. As I stated a moment ago, he had no idea of preventing, by this mode of operation, the formation of pus, but fully expected that pus would accompany the operation just the same as formerly; hence, you can imagine Mr. Lister's surprise, and the surprise of surgeons generally throughout the world, when the report of his work was given to the public. But even after a report of his work and the wonderful results attending it—wonderful because they were so unexpected—even after all this, the surgeons were not yet ready to believe that micro-organisms were responsible for pus formation. They still clung to their former idea that suppuration was a natural result of inflammation and would invariably follow the inflammatory process.

In 1881 the World's Medical Congress met in London, and a German surgeon, named Volkman, made the statement in that meeting that "pus would never form except when micro-organisms were present," and that "wounds made and cared for in individuals, no matter how bad the condition generally of the system of the individual, these wounds made and cared for under aseptic conditions, would heal without pus formation." Even at this time, in the light of the results of his own experiments, Mr. Lister himself stated that that was an exceedingly extreme view to take and did not then believe it to be true.

TWELFTH LECTURE.

Suppuration—Concluded.

By this time investigators of this subject—suppuration and the relation of micro-organisms to it—were thoroughly aroused all over the country, and the very best men in the medical profession at this time were studying the subject—were studying it carefully, thoroughly, diligently. They were collecting pus from every conceivable source, all kinds and characters of pus, and were studying this with a view, if possible, of determining whether micro-organisms were necessary to its formation or whether their old ideas, that it was a natural result of the inflammatory process, were correct.

A great many of these investigators endeavored to produce growths by making plants of pus in culture media of various kinds. And a great many of them failed; they failed simply because of the lack of knowledge and skill as to the proper methods to pursue. Others succeeded. Those who were more skilled in the modus operandi, so to speak, of the cultivation generally succeeded in their efforts in growing micro-organisms in culture media when planted from pus. These experiments were carried on, as I said, to a very great extent by a great many individuals, and as the best men in the profession succeeded in their efforts to grow micro-organisms from plants made of pus, the idea became more general that the new idea must be, very largely at least, if not absolutely, correct.

Other investigators began a series of rather unique and wonderful experiments, in their way, for the purpose, if possible, of producing suppuration without the presence of micro-organisms. Among the chief of these experimenters, perhaps, were Krause and Schlieman. These two men broke the bones in the legs of rabbits, exercising care not to tear the skin so as to form an external opening to the wound; and they healed, the majority of them, without pus formation.

After meeting with the above results they began experiments with what is termed indirect infection. Having broken the bones of the legs of these animals, they injected germs into the veins or into the arteries of the ear of the rabbit or some other portion of the animal's anatomy. Almost invariably in these cases pus would form. The germs were brought in contact with the inflamed area occasioned by the breaking of the bones and pus formation was the result. So that the results of these experiments had a tendency to fasten more firmly upon their minds that which we know at the present time to be a fact—that micro-organisms are necessary to pus formation. They also made these wounds in the hard tissue of the rabbit in a way that the skin was also severed so that the wound extended to the surface, and thus leaving it to itself. Suppuration was almost invariably the result; the germs having gained access to the inflamed area by an external opening.

Other experiments which were performed along this line for the purpose, if possible, of determining these facts, were the placing of small glass flasks containing a powerful irritant within the tissues of the animal. An incision was made, the irritant placed in the small thin glass flask and corked tightly and placed in that wound of the animal, the tissues sewed and the wound treated aseptically until it healed, and watched carefully until the inflammatory process had entirely subsided and the parts, seemingly, were in a perfectly healthy, normal condition. Then by pressure the flask was broken, the contents passed into the surrounding soft tissues and an intense irritation and inflammatory movement were the result. Many of these inflammations subsided after a time without pus formation. They were not, however, universally successful, by any means, because in connection with more or less of them pus formed. Whenever this occurred it must have been the result of carelessness in the performance of the previous steps of the operation and germs were admitted to the inner parts, or through some other source had gained access to the circulation of the blood.

Another experiment along this line which has been performed by experimenters living in our own country—by Knapp of New York and by Black of Chicago—was to take an old, dirty, rusty hairpin, render it surgically clean, aseptic, but otherwise as dirty as it might be, and press it through the tissues of a rabbit so that it passed into the eye and then could be seen. An inflammatory movement of more or less intensity was the result. But if the rabbit was not infected from some source this inflammatory movement would pass away in time. By the injection of germs into the circulation of the animal suppuration invariably followed; and having produced suppuration in one eye of the rabbit this dirty hairpin was placed in the other eye and it was found after a time that suppuration invariably occurred in the other eye also—simply proving that the germs found a way from one eye to the other through the medium of the circulation of the blood; indirect infection.

Enough has been said now, I think, that you should recognize the fact that inflammation does not pass on to suppuration without the presence of micro-organisms. This is the accepted theory at the present time, and in the light of all experimentation that has been done, from the early days down to the present time, this idea is evidently established. Also do not lose sight of the fact that it is necessary that micro-organisms must find a lodgment in inflamed tissue in some portion of the system in order to thrive and bring about suppuration. The thought is, micro-organisms do not live and thrive and multiply in healthy tissue. They may be passed into the system by artificial means, into the circulation, and if in their passage throughout the system through the circulation of the blood they do not find a focus of inflammation anywhere in which the tissues are filled with the exudates of this process, which affords a favorable field for their lodgment and growth, they become eliminated, they die. They are taken up by the human economy in some way and gotten rid of, so that in normal, healthy conditions of the human system and blood, we do not expect to find micro-organisms present as a general thing. So the further thought, right in this connection, that an area of internal inflammation, an internal focus of the inflammatory movement, may run on an indefinite period of time, and if not infected with germs the tissues will finally return to their normal condition.

Another thought that would come naturally in connection with this subject right here is this, that because of the fact that indirect infection in the system is a fact and does take place, that all surgical operations of any kind or character should be, so far as possible, postponed so long as there is a gathering of pus anywhere within the system. A person may have an alveolar abscess which, seemingly, is a trivial matter, in the majority of instances, but so long as that abscess remains, so long as the pus remains in the pus pocket in the tissues, any surgical operation that seems necessary in other portions of the body should be postponed, if possible, until this pus is gotten rid of, because of the likelihood of indirect infection; the passing of the germs from this abscess through the circulation of the blood to the wound inflicted in the operation, and suppuration resulting.

We now know, and it was also known in past years, that severe circumscribed inflammatory processes result in the destruction of tissue, to a greater or less extent, and also that the leucocytes of the blood aggregate in large masses in this inflamed area and lose to a greater or less extent their vitality, and becoming aggregated in large masses in this condition cause a separation of the tissues. This separation, with the destruction of tissue by the inflammatory movement proper, forms a cavity, a favorable place for the accumulation of pus; and simultaneously in connection with these processes the coagulable lymph of inflammation is forming about the circumference of this excavation, so to speak, in the tissues. This lymph is forming the abscess wall, becoming hardened, and coagulating in separate layers. In the walls of some abscesses we find several layers, more or less distinct one from the other, and, as we heard in the very beginning, beyond the limits of which infection does not extend. In connection with circumscribed abscesses this wall is not only made of coagulable lymph in the tissues, but it is completely filled up, absolutely studded with the leucocytes of the blood; in fact, sections of these abscess walls under the microscope oftentimes reveal almost nothing else but the presence of leucocytes, they are there in such large numbers.

The process by which pus is formed is substantially this: The inflammatory swelling—the coagulable substance in the focus of the inflammation becomes liquefied by the process of fermentation which is inaugurated through the presence of micro-organisms. Micro-organisms accumulate in this mass and grow, develop, multiply and give off a substance which acts on this coagulated mass and causes the process of fermentation to be commenced. Through this process of fermentation liquefaction of the entire mass is the result and this liquid thus formed is pus, which contains a great number of disorganized leucocytes. These form the corpuscles of pus, so that pus is this liquid filled up with corpuscles and with micro-organisms.

The micro-organisms concerned in pus formation are chiefly these: The *staphylococcus pyogenes aureus*, and this form of germs is found very largely in the pus of boils, in pus that is yellow in color, naturally—in circumscribed abscesses. Another form of micro-organism that is concerned in pus formation is *staphylococcus albus*; also the white staphylococcus almost invariably found in the saliva, and is present in the pus of the vast majority of cases of alveolar abscess. The staphylococcus aureus is very largely present also in these abscesses.

Another variety, *staphylococcus citreus*, is found in alveolar abscesses to a considerable extent; but, as I stated, in the vast majority of cases it is the white staphylococcus variety of the saliva that is found in alveolar abscess. There are a great many other varieties of micro-organisms of lesser importance than those named concerned in pus formation, but these you will get in your subject of bacteriology. All I wanted was simply to direct your attention to these particular varieties that are concerned in circumscribed abscesses, which include alveolar abscesses, with which we shall have special dealing.

There is one other variety of pus-producing micro-organisms that, however, it is well to mention, and that is a variety called *streptococcus pyogenes aureus*, and it is due to this variety that the diffuse purulent infiltrations of the tissues are brought about. Instead of causing pus formation in circumscribed abscesses, those which are walled in by a definite outline, so to speak, confined to a limited area of tissue, the pus burrows in all directions, to a greater or less extent, throughout the tissue, becomes diffused throughout the tissues of the system through the influence of this variety.

There is one other phenomenon or change within the human system, a pathological condition which accompanies this process of inflammation and suppuration, which it is quite necessary for us to understand, as we shall see in cases of alveolar abscess very frequently this pathological condition is present, oftentimes in an aggravated state, and that is fever. Fever accompanies nearly all inflammations and all suppurations. What is fever? Simply an abnormal elevation of the temperature of the body; a raising of the entire temperature of the system above that of the normal. The entire blood of the system has become more or less overheated. You must not now confound this condition of fever with the local rise of temperature connected with the process of hyperemia, or the extra heat in the milder forms of inflammation. This latter condition is simply the result of the accumulation in that particular portion of the body of an undue amount of blood, and because of the greater aggregation of blood that particular part seems to be warmer. The temperature seems to be higher than it is in other portions of the body, which is not the case. The temperature we may say in this condition is never above the normal temperature of the body. But in fever the condition is entirely different; the entire blood in the system, as I have said, is overheated, so that the temperature of the entire system is higher than normal.

What is the cause of this fever? There are poisonous products formed in suppuration, there are poisonous products continually given off by micro-organisms, and it is the absorption of these poisonous substances into the blood—in cases of inflammation and in cases of suppuration the pus itself may be and is absorbed by the blood—which in turn acts upon the central nervous system and deranges, to a greater or less extent, those powers and forces which regulate heat production and heat dissipation in the body. Their functional activity is interfered with through the presence of these poisonous materials in the blood, which act upon the central nervous system controlling this particular function in the system. So that the heat which is accumulated in the system is not gotten rid of; virtually on the same plan as the passage of the carbon dioxide from the tissues into the blood in passive hyperemia. The tissues are robbed of their nourishment and the circulation of the blood is interfered with in this process of hyperemia, thus preventing the carrying of fresh oxygen to the part, so that an abnormal condition results. The same with fever. These poisons in the blood interfere with the functions of the nerve centers so that the regulation of heat supply and heat loss is interfered with, and the result is the accumulation of an undue amount of heat in the system, causing fever.

Recapitulation of Suppuration or Pus Formation.

First, we have found that before the inflammatory process can be inaugurated it is necessary that there be an injury to the tissues, from some cause. This injury may be from one of a multitude of causes, but that tissue in some way must have received an injury. Then the next step in the pathological process is, as we have seen, hyperemia, first active, then passive, the passive form being pathological. Then we notice a slight contraction and then expansion of the vessels in the part; and the next step, the step which is really characteristic of the ushering in of the inflammatory process proper, is the accumulation of leucocytes along the walls of the vessel, sticking to them. The thought just comes to my mind in regard to this seemingly adhesive property developed in the leucocytes, whether it be in the leucocytes themselves or in something else. I think I neglected to make that point clear. After the leucocytes break away from the walls of the vessel and are carried along by the force of the blood stream, away from the field of inflammation, this adhesive property seems to be entirely lost. So it would seem that this adhesive property is developed in the walls of the blood vessel itself rather than in the leucocytes. But this process is the first that is observed in this pathological condition that is really indicative of inflammation. Then the passage of the inflammatory exudates into the surrounding tissue, the liquid portion, the corpuscular element and the fibrinous portion, the latter containing in solution large quantities of fibrinogen, which when in the tissues becomes coagulated, hard, forming the characteristic resistant swelling of inflammation. About this is the condition of edema, the swelling of hyperemia which is being kept up in the surrounding parts continually. Then infection of this inflamed area, of this aggregation of exudates from the blood in the surrounding tissue, by pus-forming micro-organisms, the process of fermentation being set up through their agency; the resulting liquefaction of this mass of tissue by the process of fermentation. This liquid constitutes pus, being filled up with the leucocytes, disorganized, life gone, and the micro-organisms themselves. This, in short, constitutes the process of suppuration.

THIRTEENTH LECTURE.

The Dental Pulp.

We will now begin the application of these pathological changes, which we have just been considering—irritation, hyperemia, inflammation, suppuration—to the special tissues which it is our duty to especially consider in our work.

It is necessary in making this application that we understand at the outset something of the make-up of these special tissues, something of their character, their functions, etc. And especially is this true of the pulp, that we may have a clear understanding of the effect—of the action—of these various pathological conditions upon it.

We will first consider the pulp. What is the pulp? You well know that it is the soft tissue which occupies the central portion of the tooth. In the crown of the tooth the division of the pulp is termed the bulbous portion, as a general thing, or the coronal portion. That portion occupying the root of the tooth is generally referred to as the root portion of the pulp. Just at the entrance of the root-canal proper, after leaving the pulp-chamber, there is more or less of a constriction, or contraction, a narrowing of this opening. In some cases in the anterior teeth this is but slight, so that there is but very little variation in the size of the pulp occupying the bulbous portion to that immediately entering the root-canal proper, but nearly always this change does occur. Especially is this true in connection with the bicuspid and molar teeth, particularly the molar teeth; these openings leading from the pulp-chamber proper to the root are oftentimes exceedingly small.

Let us now consider briefly the histology of the pulp. We should understand something of the general character of the tissue constituting this organ which we call pulp, because in some respects it is very different in its general make-up from that of any other tissue in the human system. The pulp as an entirety is not a fully developed tissue; it is not a completely organized tissue. It resembles, if you please, the semifetal tissue, that which has not yet become thoroughly organized and developed into a perfect form or type of tissue.

The individual cells in the tissue of the pulp, as you see represented by this first picture (indicating), do not lie closely together, as they do in most all other tissues, especially as they do in the connective tissue of the body. These spindle-shaped cells in the pulp lie far apart one from the other in the greater portion of the tissue, so that between these cells there are spaces of greater or less extent, which are filled with a gelatinous mass, or matrix.

In the connective tissue variety we find these cells lying closely together, these processes which extend from the cells in different directions, interlacing one with the other tightly, in close apposition, so that the body of the cells and these processes interlacing constitute a perfectly formed tissue within themselves. In the root portion of the pulp these cells are in closer apposition than they are in the bulbous portion, simply, I presume, because the tissue in the root-canal occupies a much smaller space and the tissue is crowded more closely together. These cells that you see represented along the sides (indicating) represent the odontoblasts. Between the odontoblasts and the pulp tissue proper there is generally a space of more or less extent, as you see represented in this picture (indicating), which is filled in for the most part with a gelatinous substance, instead of being occupied by the cells proper. It is only immediately about the blood vessels and the nerves of the pulp that these cells are aggregated in closer apposition one to the other, so that they come anywhere near forming in themselves a perfectly organized tissue.

The pulp tissue contains no system of lymphatics. There is, however, a difference of opinion on this particular point. Some investigators, especially of the early times, claim that the pulps do contain a system of lymphatics, but investigators of recent years have been unable to demonstrate this fact, and it is generally acceded at the present time that they do not contain a lymphatic system, as the other tissues of the body do. At any rate, this fact remains, that if there be lymphatics in the pulp, they do not perform their normal functions under pathological conditions of the pulp as they perform them in other tissues under similar conditions. A very important fact, and one which I want you all to grasp now and understand, for when we come to consider the diseases of the pulp, especially, we will have occasion to refer to this again.

These cells, as I said before, are what are termed spindle-shaped or star-shaped cells, and we notice here (indicating) a process extending from either end of these cells. I think none of them in this picture (indicating), present more than two processes, but very frequently we find three or four, or even more, of these little processes extending in every direction from the cell itself, so that they ramify throughout this gelatinous mass the pulp tissue—in every direction—another condition which is different from that of nearly every other variety of tissue of the body.

I wish now especially to call your attention to this layer of cells to which we referred a moment ago—the odontoblastic layer of cells, that occupies, as you see represented here (indicating), a position immediately inside of the dentinal walls of the pulp-chamber and canal, and these cells occupy this position throughout the entire inner wall of the pulp-chamber of the bulbous portion and the root portion, forming a layer completely lining the inner walls of the chamber.

These cells have, really, a double function—physical, and, in a way, sensory. The physical function of the odontoblasts is the building, or the superintendence of the building, of the dentine tissue, under the general superintendency of the pulp. Before there is any calcification or hardening of this portion of the tooth structure, the dentine, there are processes extending from these cells in a lateral direction. In the vast majority of instances, as you see represented here (indicating), as a rule, only one of these processes extends from the odontoblastic cell. Sometimes, however, we find two of these processes, as represented in this cell (indicating), but that occurrence is comparatively rare. These processes are what are termed the fibrils of Tomes, a gentleman named Tomes having discovered their existence and first described them.

These fibrils are, to all intents and purposes, of the very same substance as the cells themselves. They are really nothing more nor less than a growth of the cell substance proper. When the proper time comes in the development of the tooth, the inorganic substance of the tooth, the lime salts, if you please, is deposited about these fibrils and afterward calcifies or hardens. The fibrils, as this process takes place, are gradually contracting, narrowing, becoming smaller; yet, they do not become extinct; they continue to occupy the central portions of what are called the dentinal tubuli, so that in each individual tubule in the dentine there is a hollow space occupied by this organic material, the fibrils of Tomes, and that extending to the very circumference of the dentine, underneath the enamel. This element in the pulp, the odontoblastic layer, and these fibrils, is a system that is especially peculiar to the pulps of the teeth. We do not find in any other portion of the body, in any other tissue of the system, an element in its make-up just like this, whose construction is like this, whose functions, withal, are similar to the functions of this element.

These odontoblastic layers, as you see (indicating), are arranged in a columnar manner along the inner walls of the dentine; that is, arranged in a column of more or less regularity throughout the entire inner circumference of the dentinal walls. They are, for the most part, flask-shaped in their general appearance. Sometimes in our specimens, which are prepared for examination with the microscope, we will find these ends, which lie immediately against the dentine, considerably flattened, but that is not the natural shape of that portion of the odontoblast. It is only in those specimens which are compressed or contracted in the process of staining and hardening, so that those cells are pushed against the hard wall of dentine and in that manner flattened.

Blood and Nerve Supply of the Pulp.

It is quite important that we understand now something of the blood and nerve supply of this special organ. We have represented here in this picture (indicating), the alveolar plate of bone, the peridental membrane, the cementum, the dentine, the pulp, the foraminal opening, the blood vessels ramifying throughout the peridental membrane, in the soft tissues in the apical space and extending through the hard tissue—the alveolar plates. While these teeth originally are in the process of development the blood supply to this pulp comes from various sources, and it is a question whether or not at this early period the blood supply mainly is from the inferior or superior dental arteries, as the case may be, because it is a fact that the alveolus and the peridental membrane are exceedingly rich in blood supply. The blood vessels pass into the peridental membrane and about the end of the root they anastomose very freely with the arteries or blood vessels that come directly from the inferior or superior dental artery. So that even at this time it is possible that the blood supply from the dental arteries may be cut off, and yet, because of this free anastomosis in the apical space of the arteries from these other sources, the blood supply to the pulp may be kept up.

But after the deposit of the inorganic material of the tooth has taken place, after the calcification of this substance occurs, this anastomosis of blood vessels is very largely cut off, although not entirely so in all instances; it is a fact that the cases where it disappears entirely are very few, but very largely it is done away with. However, in the perfectly formed tooth, the blood supply enters the pulp through the foraminal opening by a single artery, with other arteries anastomosing with it, in most instances, in the apical space, leading directly from the inferior or superior dental artery, according to whether it be a lower or an upper tooth. So there are not several individual or distinct arteries passing through the foraminal opening into the pulp tissue, and the venous blood is carried away from the pulp through the foraminal opening into the outer parts, by a single vein, in almost every instance in adult life. In teeth possessing two or more roots, of course, there is a distinct vessel—an artery and a vein—for each root.

Occasionally we see specimens of teeth through which there are lateral openings in the dentine (from the alveolus), through the peridental membrane, through the cementum, through the dentine into the pulp, through which blood vessels pass. Whenever that is the case, of course, the blood supply comes in part through those vessels. But instances of this kind are rare. While this entire tooth (which is to be after development occurs), is a soft, pulpy mass (which it is in the beginning), it is supplied with numerous blood vessels from every direction, but as the deposition of lime salts takes place and their hardening occurs, this lateral system of blood vessels to the pulp is very largely cut off, and only in instances where these arteries persist in their existence do we find one occasionally remaining in adult life. If I remember correctly, Dr. Black has said on this particular point that during his entire practice of dentistry he has observed but eight or ten teeth with these lateral openings, so you may be certain that blood supply from this source is of rare occurrence.

The nerve supply of the pulp of the tooth is derived virtually in the same manner as is the blood supply. The nerve fibrils which supply the pulp pass in through the foraminal opening in a single bundle, and in adult life they are furnished mainly by the inferior and superior dental nerves. After this bundle of nerve fibers passes through the foramen it sends off its fibrils in all directions in the tissue and supplies freely the entire pulp.

Irritation of the Pulp.

We are now ready to apply these pathological conditions, beginning, first, with that which is necessary in other tissue to induce the process of inflammation—irritation. The pulp of a tooth may become irritated from a multitude of causes. The causes of irritation of the pulp to which it may become subjected are too numerous for us to consider individually. We will only take time to consider the most important ones, or those which occur most frequently. And, first of all (leaving the most important of the few we shall mention for last consideration), a blow upon the tooth may result in a shock of more or less severity to the pulp; it is in consequence irritated and the irritation is so great that it cannot recover from that shock. The irritation continues and the pathological changes which are induced thereby follow in their order, just the same as they do in other tissues of the body. This irritation may be induced by a rapidly revolving burr, which you are using in your engine. A burr used upon the dentine, revolving rapidly and held there for a considerable time, generates heat, and through the medium of this heat, which is transmitted to the pulp, the latter receives a shock from which it is unable to recover. This irritation may be induced by the use of the disc in the engine, as well as by the use of the burr in polishing large metallic fillings which approach closely to the pulp, the metal becoming heated, and the pulp in turn is likewise irritated. I have known this trouble to arise from the use of strips, which, however, is not liable to occur, as they are rarely ever used with sufficient vigor to cause irritation, but occasionally it will occur. Too rapid movement of the teeth in wedging, or in cases of regulating, frequently cause irritation of the pulps. So that in connection with the use of these various articles and methods in your work be on your constant guard, because trouble may follow.

Perhaps one of the most prolific sources of irritation to the pulp is through the medium of thermal changes—heat and cold—to excess. The pulp is an organ which is especially sensitive to thermal changes; more so, in fact, than any other class of tissue within the human system. It resents, for some reason, the change of temperature more quickly, more vigorously, than any other tissue. We drink ice water and are in the habit of drinking hot drinks, such as tea or coffee, and we do not notice the application through this medium of that cold or heat to the pulp tissue. It does not seem to affect it simply because we have formed the habit, from natural instinct, of shielding the teeth with the muscles of the cheek and the tongue, and passing that liquid from its entrance in the mouth down the throat without actually coming in contact with the teeth. We do it unconsciously, so that this fact of oversensibility of the pulp to thermal changes is not noticed especially. But any of you who may entertain doubts upon the accuracy of this statement, the next time you drink ice water take a mouthful of it and extend the muscles of the cheeks so that it may pass freely about the teeth, especially the posterior teeth, and note the result. Likewise with hot tea or coffee.

Another very common source of irritation of the pulp is from carious cavities, as you see represented in this picture (indicating). Decay has extended through the enamel and is operating in the dentine. These fibrils that you see extending laterally represent the fibrils of Tomes; these enlarged ends inside this dark line (indicating) represent the odontoblasts themselves. The process of decay has gained access to the surface of the dentine, and even though the decay may be very slight indeed, the ends of these fibrils are irritated by the presence of micro-organisms, by the contact with the poisonous materials which the micro-organisms are continually throwing off in this process of decay. And, as we stated before, these fibrils are, in fact, a part of the very substance of these odontoblasts themselves, and this irritation from this cause is transmitted through the medium of these fibrils to the odontoblastic layer of cells. In fact, when you are cutting on the surface of the dentine, cutting these fibrils, you are just as virtually cutting the cells themselves as you are the ends of the fibrils.

It is a fact that the dental pulp does not possess the sense of touch which is a localizing sense. It is an internal organ, and all internal organs of the body that are not intended naturally to come in contact with foreign substances from without, are not supplied by the human economy with the sense of touch. Their only sense is that of pain, which is a warning sense. For instance, pain may occur in your stomach; the stomach does not possess the sense of touch or the localizing sense, and you are unable to tell positively whether that pain is in the stomach, or whether it is in the transverse colon, or whether it is in some other organ in the immediate vicinity, unless you have a thorough knowledge of the parts, of the character of the ailments of the parts, of the nature of the pain manifested by the individual parts.

Then the other function possessed by the pulp of the tooth is the function of pain, a sensory function. This irritation is passed along these fibrils to the odontoblasts. The odontoblasts are placed in such close apposition, such close relation, physiologically speaking, with the tissue of the pulp itself that this irritation is transmitted to the pulp tissue, and thereby is transferred to the sensorium.

This process of irritation from carious cavities, in connection with that of thermal changes, is one of the most prolific sources of irritation to the pulp, because the irritation of those fibers places the pulp in a hyperesthetic state; it is thus more sensitive to the effect of thermal changes than otherwise, so the two combine and bring about the irritation of the organ.

After the irritation has been transmitted to the pulp, the next step in the pathological process is that of hyperemia, and in most instances in which irritation is set up by these causes, the entire pulp is included in the hyperemic process, and all the various conditions attending hyperemia are present, except the one condition, the characteristic condition of hyperemia, that of swelling. The pulp tissue cannot swell in this diseased condition, hence the severe spasms of pain with each new influx of blood. That is a fact which you must remember. The pulp is inclosed within bony walls and does not swell. The vessels supplying that portion of the irritated pulp with blood become enlarged, the blood is brought to that part in larger quantities than normal; but you will find in specimens in this condition, examined under the microscope, that in order to make room for the enlarged condition of those particular vessels other vessels in that part have become contracted. True inflammation follows this condition of hyperemia, the same as in other parts, with the exception of swelling, as in hyperemia. The inflammatory process continues, the pulp is unable to return to its normal condition and dies, usually by infarction, and suppuration follows.

FOURTEENTH LECTURE.

A few more words this morning regarding the irritation of the dental pulp. You remember we considered a few of the chiefest of the causes of this trouble. We did not refer, however, directly to one cause which is quite prevalent, and one of the chiefest, and that is the exposure of the pulp tissue directly to the external world, so to speak, through caries. Oftentimes the carious process in the cavity of the tooth extends all the way to the pulp tissue and exposes the latter positively before any irritation is manifested in the pulp. This is very seldom, however. Whenever the carious process has penetrated very closely to the pulp there is almost invariably more or less irritation following, the irritation being conducted to the pulp proper through the dentinal fibrils and the odontoblasts.

As soon as direct exposure of the pulp occurs, even though that pulp has remained healthy, it being exposed to the fluids of the mouth,, to the products of the carious process and all that, irritation at once results and all the other conditions following up to and including suppuration. Here you see the result of a direct exposure of the pulp (referring to picture), this dark line representing the formation of the carious cavity, this representing the horn of the pulp. In these cases we find suppuration occurring first in a very small portion of the pulp, before any considerable portion of the pulp becomes involved in this pathological condition. From the other forms of irritation, from thermal changes, from heat induced by the disc, or anything of this kind, the entire pulp is almost always involved in the pathological state of irritation and inflammation at once, not a small portion, as represented here (indicating), but the pulp in its entirety becomes inflamed, after which death frequently results, as I stated the other day, through the process of infarction. So that inflammation and death of the entire pulp take place almost immediately following the irritation, unless the irritation is so slight that the pulp is able to recover. But in this condition, as represented in this picture (indicating), we find but a small portion irritated; a small portion inflamed; a small portion dead, and suppuration has taken place after the presence of pus-forming micro-organisms.

I wish to follow this process of suppuration of the pulp now, this slowly progressive form, before passing on to the conditions of abscess. Even in this form of irritation, such as represented in this chart (indicating), where a small portion is involved first, in many cases the irritation passes quickly throughout the pulp tissue, the inflammatory process involves the entire pulp tissue in a comparatively short time, the pulp dies in consequence and suppuration takes place. Oftentimes the entire pulp will become thus involved and die and become suppurated in anywhere from eight to fourteen hours' time, but this is not the rule when a small portion of the pulp is first involved.

In the majority of such cases the progress of irritation, inflammation and suppuration is slow, what is called a chronic form of suppuration, and this inflammatory process and suppurative process follow, as you see indicated in this picture, the central portions of the pulp tissue being involved instead of the entire circumference of the pulp. As this destructive process progresses gradually toward the end of the root it follows farther on in the central portion, simply because the main blood vessels of the pulp, which it is prone to follow, occupy that portion of the tissue, especially the veins. So we have a chronic form of suppuration in the tissue, and slowly, gradually, continuously, this process of suppuration works its way to the apex of the root, involving the entire pulp.

I say continuously, which is in the main correct. However, it has been observed by investigators in some instances —I have seen some myself in specimens—where it seems that the pulp endeavors to throw off this diseased condition and to heal this wound which has been inflicted; to cicatrize, if you please. But I want you to remember this fact, that the odontoblastic cells lining the pulp-chamber do not form epithelial tissue, and while there is a seeming effort on the part of the pulp to heal this wound, to form a layer of epithelial tissue over the previously wounded tissue, it cannot do it, simply because it does not possess the ability to form that kind of tissue. Cicatrization simply means the healing of a wound and the covering over of the wound with epithelial tissue. So that the pulp, once exposed, even though it tries to ward off these disease-producing elements that are continually coming in contact with it, fails, and simply remains in the future thus exposed to infection, as it was at first.

Alveolar Abscess.

We come now to the consideration of the soft parts occupying the apical space in which the abscess is to form. You remember what I told you in the beginning of the consideration of this subject, that any abscess formed within the alveolus about the teeth, which is in no wise dependent upon the death of the pulp, should not be referred to as an alveolar abscess.

In fact, strictly speaking, an abscess occurring anywhere in these tissues, about the alveolar process, is an alveolar abscess, as to anatomical location. But as we use the expression —alveolar abscess—in our practice it should not be thus considered or thus referred to. Only those which are formed as a result of the death of the pulp—and no alveolar abscess can form in connection with a tooth until the pulp, or at least a portion of the pulp, has died. I say a portion of the pulp, because in some of the teeth, the bicuspids and molars, this suppurative process will progress, involve the entire bulbous portion of the pulp, and in those bicuspid teeth which possess two separate roots, two separate root-canals, two separate masses of pulp tissue, the suppurative process may follow the tissue in one of the roots, pass through the foramen and abscess result in consequence, and the tissue remain perfectly healthy throughout the length of the other root of that tooth. Such cases as this are comparatively rare, but once in a while we see them. The same with the molars.

It is necessary now that a portion of this infectious material or the poisonous elements in it—not septic, remember the difference between the two expressions—shall pass through the foraminal opening, and come in contact with the soft tissues in the apical space. They are in turn irritated and pass through all the stages of the inflammatory process and are infected by micro-organisms, which may follow the suppurative process of the pulp or may be brought in contact with that tissue through the medium of the circulation of the blood, and pus forms in this space, this constituting alveolar abscess. Of course, it is first necessary that this pus shall form entirely within the bony walls of the alveolar plates of the jawbone, at this point, and when it is thus formed, as represented in this picture (indicating), and thus confined within those bony walls, it is commonly referred to as blind abscess. Other expressions less frequently used are cold abscess; sleeping abscess—although their slumbers are not always as profound as they might be—dormant abscess, although the latter word, dormant, is an exceedingly poor one to be applied to this form of abscess, because an abscess with a fistulous opening may be properly referred to, in some conditions, as a dormant abscess. When the expression is used it should be dormant blind abscess. Blind abscess is the common, everyday expression.

In the majority of cases of blind abscess the peridental membrane along the side of the root covering the apex is not destroyed to any considerable extent; in fact, it is a characteristic of this membrane to resist the destructive effects of pus formation, the destructive effects of the inflammatory process, and the fact remains that the hard tissue itself is absorbed away in this process of pus burrowing, oftentimes more readily than is the soft tissue of the peridental membrane. So that in the formation of this blind abscess the peridental membrane will be found intact in its entirety right up to the opening of the foramen itself. But in cases of blind abscess, which become chronic—which we shall consider later on—the peridental membrane becomes more or less destroyed along the end of the root, as represented in this picture (indicating).

We are now positive that pus has formed in the apical space; that is, we are positive and yet we do not know it; we do not know that we are positive. Since pus is there, the next question is how shall we diagnose the case. And this question of diagnosis is one of the most important phases of our work. Correct diagnosis of troubles, of diseases with which we have to deal, is all-important. And I wish we had a department devoted exclusively to diagnosis.

Let us look carefully now to the symptoms which we would naturally expect to find in connection with a case of blind abscess. Of course, there will be pericementitis, and pericementitis will be present in all degrees of severity. Sometimes this abscess will form and there will be but slight inflammation of the peridental membrane, so that there is not very much pain occasioned when pressure is exerted upon the tooth. The rule is that there will be a very considerable tenderness of the tooth manifested to pressure, because of the severe inflammatory movement going on in the peridental membrane. The gum tissues, as well as the membrane, will be more or less congested, inflamed, highly reddened, sometimes slightly swollen, although not necessarily so, but always more or less congestion. In connection with the tenderness of the tooth to pressure and this congested appearance of the gum tissue about the root, there will be almost constant pain in these cases of blind abscess, and this pain is of a peculiar character; not that steady, constant, persistent pain, which is present in connection with ordinary ailments of this kind, but it is of a beating, throbbing nature, not unlike the pulsations of the heart. The sensation to the patient in those parts is as if something were in there enlarging and then contracting and keeping up that process of throbbing and beating; the parts being subjected to great pressure by the formation of pus and the generation of gases, etc. The pain may be, and often is, most excruciating, most severe, although sometimes it is not very severe.

There will be in connection with the formation of this abscess a swollen, inflamed, tender condition of the maxillary glands, about the angles of the jaw especially. This condition is rarely present in connection with simple inflammations, but in connection with pus formation it is almost invariably present, and oftentimes in quite an aggravated state. The crown of the tooth will have become, in the majority of instances, more or less discolored upon the death and suppuration of the pulp. The swelling of the membrane will occasion looseness of the tooth, and if the swelling is considerable this looseness will oftentimes be very great.

These symptoms, in the main, are the ones that you will naturally look for in your diagnosis of a case of blind abscess, so far as an ocular or a digital examination about the part is concerned. Especially this throbbing pain, this pathological condition of the maxillary glands, and there will be fever also—one of the most important symptoms in connection with suppuration. Almost invariably the patient will have more or less fever, and oftentimes the body temperature rises exceedingly high in connection with aggravated cases of alveolar abscess. The normal body temperature is about 98½. In connection with alveolar abscess the temperature has been known, more than once, to rise as high as 106, and an individual who is not unusually strong and robust physically, will not endure a temperature of 106 a very great while.

Let us exclude now these three last conditions in connection with pus formation—elevation of body temperature, pathological condition of the maxillary glands and this throbbing character of pain. If we find none of those three conditions present we are not justified in concluding that it is a case of abscess. All the other manifestations we have described might be present in a simple case of pericementitis, with no pus formation in the root-canal or in the tissues in the apical space. So that in diagnosing these cases where you suspect abscess in connection with the other manifestations, look to the character of the pain, look to the condition of the maxillary glands, look to the bodily temperature, and if you find these present you are almost sure that pus has formed.

We adjust the rubber dam and open into the pulp-canal; we remove the debris, and in a case of this kind, where we deem positive that there is an abscess, we need not exercise any care, especially in the first sitting, about the removal of the infectious material from the canal, but we may remove it thoroughly. Of course, we must work carefully and cautiously, because we are not absolutely certain that our diagnosis is correct; but remove all the debris under aseptic precautions clear to the end of the root.

What is necessary now, in connection with the other pathological changes in the parts, before we are positive that an abscess has formed? The flow of pus. That is the one positive element in our diagnosis of these cases. In the majority of these cases it will not be necessary for you to work thoroughly, carefully to the end of the root and effect an opening through the foramen before you will be rewarded with a flow of pus. As soon as you have opened into the pulp-chamber the pus will flow out without any more time or pains being necessary to reach the end of the root.

However, this doesn't always occur; occasionally it will be necessary for you to open through the foramen; the natural opening has become clogged from some cause, so that the pus does not flow freely from the pus pocket into the root-canal. In doing this you should always have a care as to what you do. Try, if possible, simply to force out the foreign material which has clogged the foraminal opening without disturbing the hard parts of the root of the tooth. Sometimes you cannot do that; sometimes it is necessary to cut the hard parts in order to effect an opening into the apical space, but never do this except in cases where it is absolutely necessary. The danger is this—Nature has formed the end of that root, as it has all the other parts of it. Nature has provided for that natural opening through the apex, and in order that the tooth will remain in the future, and serve its purpose to the best advantage, that hard tissue should never be disturbed. If cut away it leaves an unnatural condition, and because of that disturbance of its natural formation the absorptive process is very likely to set in; the cementum becomes absorbed away, the process continues and involves the dentine and the apex of the root, as no doubt you have often seen in cases which you have extracted. That is a very important item and one which you should be careful about at all times.

The treatment of this case naturally follows. This is an acute blind abscess, acute suppurations being the only form we have considered thus far.

We open into the tooth under aseptic conditions, with the rubber dam in place, always. The pus should be drained as thoroughly as possible. Let all the pus escape that will from the pus pocket through the root; wipe that away with cotton on your broach passed into the root-canal. After the pus has flowed out all that it will of its own accord, by slight, firm, gentle pressure with the fingers on both the labial and lingual surfaces, or buccal and lingual, as the case may be, opposite the end of the root, force all the pus out that you can at the first sitting and wipe it away thoroughly. Peroxide of hydrogen or 3 per cent pyrozone, for a thorough cleansing of the canal, are excellent agents to use at this time, although it is necessary that you be very careful not to force any of this agent through the foramen at this sitting, unless you are certain that the foraminal opening is free. The necessity for exercising this care you are familiar with.

The instant peroxide comes in contact with pus the process of oxidation is inaugurated, and very vigorously, if your medicines are fresh. The pus is being destroyed by those agents by the process of oxidation. There is a great expansion of those materials; undue pressure is exerted in those parts and severe pain is the natural result. In all of these cases where I am sure that the foramen is freely open I never hesitate to force a moderate quantity of these agents through into the apical space, because if any portion of the pus remains there it will be destroyed by these agents in less time and more effectually than it will with any other. This done, the canal should be dried, and some essential oil, which is an antiseptic and a germicide, and which is not irritating to the soft tissues, should be placed therein.

"1-2-3" as a dressing in these root-canals is as good an agent as you can use at this time. It is non -irritating to the soft parts, it is an excellent antiseptic and germicide. Oil of cloves is a good agent to be used in this connection. Oil of bay, our new antiseptic, is an excellent agent, so far as its use and experiments with it thus far indicate. Beechwood creosote may be used. Any of these agents which will not further irritate the soft parts, but which will destroy the germs and render the parts healthy, may be sealed in the root-canal.

FIFTEENTH LECTURE.

Alveolar Abscess—Continued.

There is another form of chronic blind abscess to which I want to call your attention this morning, and that is one in which the pus burrowing has continued through the alveolar plate and occupies an area of more or less extent under the soft tissue; an acute abscess, to begin with, which has burrowed through, as you see represented here (indicating). The treatment of that case has not been attended to and the pus has found an opening through the soft parts and is discharging into the mouth underneath the lip. It has not received treatment, but has run along and become chronic—a chronic abscess with a fistule—this external opening being the only means of escape for the pus, there being no cavity or positive opening into the pulp-chamber and through the foramen into the pus pocket, so the pus could escape in that way. But in the course of time a cavity develops in the crown of the tooth and opens into the pulp-chamber, and the pus, instead of discharging through this external opening, begins to escape somewhat through the tooth itself. It continues thus, and as the amount of pus which is escaping from the external opening grows less and less, and the discharge through the tooth becomes more and more, this external opening or fistule gradually closes of its own accord, and it will continue that way until the fistule heals entirely; not only the fistule through the soft parts will heal, but the opening through the plate of bone will also fill in with hard tissue and the case returns, practically, to what it was originally, before the pus burrowed through the bone—blind abscess, but now chronic, and discharging through the tooth.

Occasionally you will come across just such a case as this. You will not, however, find them very frequently. I have seen a number of them, and they are important because there are almost invariably certain complications in connection with them which, if remembered, will materially assist you in determining the proper mode of treatment. There will be, almost invariably, an accumulation of serumal deposits (which condition has been previously referred to) upon the denuded surfaces of the apex of the root. Not only that, but the inner surface of the bone will,, very likely, have become carious to a greater or less extent. So that, if in your treatment, as you would proceed to treat an ordinary case of blind abscess, the case does not heal readily, the flow of pus continues, you are justified in concluding that those complications, either one or both, are present, and proceed with your treatment accordingly, which will be as outlined the other morning—opening through from the external surface into the apical space and treating through that opening; the opening large and free, so that you can, without hindrance, remove the deposits and the diseased bone as well; then treating with antiseptics until the case heals.

We may as well speak of the character of the discharge in these cases of acute and chronic blind abscess, a knowledge of which will aid you materially in determining whether it be an acute or a chronic case.

In these abscesses which are acute the pus is almost always of a character which is generally referred to as laudible pus; it has been quickly and recently formed; it is of a creamy consistency and varies in color from light, approaching white, to yellow, depending very largely upon the character of the micro-organisms concerned in its formation. The discharge that will come away from these cases of chronic blind abscess, instead of possessing those characteristics, will be thin, watery, purulent, more or less odor connected with it all the time. So that in studying the character of the discharge from these cases you are materially assisted in determining the conditions connected with them.

There are cases of these abscesses, blind especially, in which the parts about the end of the root are so thoroughly diseased, the workings of the pathological conditions have been in vogue so long, and they are so sensitive and tender, gases being constantly generated, that the case will not admit of being sealed, even. Almost the moment you seal the cavity in the crown of the tooth there is trouble. The generation of gases, etc., their expansion, causes pain. Sometimes you will be bothered very much with just this form of difficulty, and it would seem that it is impossible to seal the cavity for even an hour's time without the patient suffering very considerably from the pain that results. What shall we do with such cases? We do not want, wherever it is possible to do otherwise, to leave the cavities in the crowns of teeth thus afflicted, open, so that the saliva and other foreign substances in the mouth can gain access to the root-canals. That is not good practice, as a general thing, but occasionally it is the only thing we can do, for a time, at least. And in connection with these cases that act thus—that will not behave when sealed, that are determined to cause intense pain almost the moment they are sealed—it is my practice, and I know not what else to do, except to leave the cavity open for a day or so until the effect of the medicine that is used in the treatment can be absorbed through the foramen and disseminated somewhat through the diseased tissue, and its quieting, soothing influence upon that tissue has taken effect, so that we can begin gradually to seal the case, even if only for a short time at first. You will also meet with this difficulty more or less in connection with the treatment of cases of putrescent pulp. But do not form the habit of leaving them open if you can possibly avoid it—only in these extreme cases, as outlined. However, I will say this —that I believe when a thread of cotton that fairly well fills the root-canal, saturated with the essential oil, is passed into the canal to the end of the root, filling the bulbous portion of the pulp-chamber, that the saliva will not percolate through that to any extent. Except coming in contact with the dentine in the crown of the tooth itself, in my judgment, left this way for a short time, it can do no other harm, and it certainly does result in great relief to the patient, permitting the gases to escape as rapidly as they are formed, thus doing away with that intense pain that otherwise would take place.

There is another condition connected with the treatment of blind abscess to which I want to call your attention, as it is a very important one—one which does not frequently occur, however—and that is, after your treatment of blind abscess for a time and the odor is destroyed, you seal the cavity and it remains any length of time without causing trouble. I say any length of time; any reasonable length of time—two or three weeks, a month, six weeks or two months—without a change of dressing. There is no pain, and yet, the moment the case is opened there is a copious discharge from the root-canal coming from the tissues in the apical space through the foramen. You examine that carefully, smell it; there is no odor. Its consistency may be that of genuine pus and its other characteristic appearances may be very much like that of pus; or in consistency it may be very much thinner than pus and much lighter in color than ordinary pus is, and if you do not know just what that is you take it for a continued flow of pus, whereas, it is nothing but a flow of serum from the parts.

In some cases you will treat this with antiseptics, you will treat it with astringents, you will treat it with all known agents proper to be used in connection with the case, and the more you treat it, seemingly, the greater the flow of the serum; it will not stop. What shall be done with such cases? Get the flow of serum as thoroughly under control as you can at the sitting, dry the canal as thoroughly as you can, select a gutta-percha cone that will as nearly fill the canal as possible, without passing beyond the apex of the root. If the canal is a large one, soften two or three and roll them together, then fill the canal as you would any other, as thoroughly and carefully as possible, and there will be no trouble. The lymphatics take care of the serous exudate, just the same as they care for it during the treatment while the case is sealed.

Burrowing of Pus.

The bone tissue forming the alveolus is quite cancellous in its structure—porous, spongelike, and, because of this characteristic of formation, it is very easily and rapidly absorbed in the process of pus formation. There are also haversian canals passing through the structure in this locality, they being more or less numerous. These become enlarged by action of the pus and other elements, and thus afford a ready means of escape for the pus into the soft parts.

If you do not secure the case for treatment as soon as the pus has formed in the apical space it will continue to burrow through the plate of bone, as you see represented here (indicating) in a surprisingly short period of time, anywhere from twelve to fourteen hours, or even less time than that.

One of the most severe cases, I think, that ever came under my observation, of the formation of acute abscess, occurred within the space of fourteen hours' time from the moment the patient experienced the first evidences of pain, or of inconvenience in the apical space, all through the inflammatory process, suppuration, pus formation and the burrowing of that pus through the bone underneath the soft tissues, occupying a very large space under the gums. It was connected, by the way, with an upper central incisor, and the pus burrowed laterally, so that the fluctuations could be had opposite the cuspid teeth on either side. There were three distinct points forming on the gum surface where the pus was about to break through. So you see sometimes this is an exceedingly active process, and the activity of this process in connection with these cases depends very largely upon the character of the micro-organisms concerned in the pus formation. Some of them act very energetically indeed, while the action of others is very slow.

In connection with this form of abscess there is always more or less swelling, not only of the immediate parts concerned in the pus formation, but of the tissues of the entire face, and this swelling oftentimes is very considerable; sometimes slight. The swelling which took place in connection with that severe case just referred to was seemingly as great as any swelling could be in connection with a case of abscess. The entire face was swollen, apparently, as full as the skin could hold. The tension was great. The young man was almost unrecognizable because of the swelling. The character of this swelling, for the most part, is not the true characteristic swelling of the inflammatory process, but is that of edema. Of course, in the parts immediately about the pus formation, the swelling is the characteristic swelling of inflammation, but that which causes the entire face to puff up is the swelling of edema, the result of the hyperemic process, which, you remember, accompanies all inflammations, and which takes place to a greater or less extent all about the focus of the inflamed area.

What are we to do with such cases as these? What is the treatment? The first thing in a case of this character, as represented in this picture (indicating), is to evacuate the pus and evacuate it as thoroughly and promptly as possible.

There are some little points in connection with the use of the lancet in these cases which are always well to be observed. In opening through the tissues underneath the lip the lancet must be held firmly in the fingers. That is one essential point. More than once I have seen the lip and the adjacent soft parts lacerated very considerably simply because the operator held the lancet loosely in his fingers, and in cutting the gum tissue, the patient, by a sudden movement of the head, jerked the knife out of his hand, or it rotated in the fingers and thus injured the adjacent parts. So at all times hold a firm grip upon the lancet (demonstrating). That is an exceedingly important point in this connection, and one which you are liable to forget at the beginning of this work, possibly in connection with the first case that you undertake to open. But after you have had a little experience all these little nervous manifestations will leave you, so that you will remember these things.

The cutting edge of the blade of the lancet should always be held away from the surrounding parts. As the lip is reflected upward the blade of the lancet in approaching the patient should be turned outward away from the parts, not undertaking to cut with the cutting edge of the blade directly toward the other parts of the mouth. In connection with those two points, the other fingers—those which are not especially concerned in holding the lancet—should be placed firmly upon the teeth or some adjacent point that is not movable, so that if the patient suddenly jerks his head in any direction your hand follows the movement of the head instead of being displaced, so that the relative position of the blade of the lancet and the part upon which you are working remains the same. Then the opening should be made as nearly as possible in the most dependent point of the abscess sack, so that the force of gravitation will assist in discharging the pus. And next, the opening thus made through the soft tissues should be large and free. Never be satisfied with the passing of a narrow blade straight through those soft parts, making an opening the width of the blade itself, but when passed into the pus pocket give it a movement upward, so that the tissues are severed a distance two or three times the width of the blade, so that the opening is large and free, that the pus will be able to escape freely. This done, the pus should be forced out by pressure with the fingers as thoroughly as possible. This part of the operation, opening through the soft tissues, should be done before the rubber dam is in place, so that you are able to work without hindrance. This part of the treating process accomplished, the rubber dam should be adjusted and an opening effected into the pulp-chamber, all the contents of the pulp-canal should then be removed and the opening effected through the foramen. In opening through the foramen remember the caution about not disturbing the natural continuity, so to speak, of the tissues about that opening. At any rate, the opening must be positive in order to treat these cases intelligently and thoroughly.

Let me say right here that a case of this kind—an acute abscess—may recover entirely without the forcing through the entire tract of the fistule of any medicinal agent; simply a discharge by mechanical means of the pus externally and a thorough cleansing of the root-canal and subsequent treatment of the same. Cases of this kind may heal with that treatment, but you should not, in connection with any case, work upon that hypothesis. It isn't the proper thing to do. You will find old practitioners, successful practitioners, pursuing just that form of treatment, very largely, in connection with these cases, but I think it is not the proper course to pursue. You should cleanse that entire diseased tract just as thoroughly as possible if you would do your best toward eradicating the disease. So you should force through the entire diseased tract at the first sitting some liquid which is non-irritating, which is non-oxidizable in connection with the pus, simply for the purpose of carrying the excess of the pus away, to cleanse the entire tract as thoroughly as may be. Various agents may be used for this purpose. The one which I prefer is simply carbolized tepid water. Warm water with a small amount of carbolic acid in it, not enough to form an eschar, but just enough so that its odor is distinct and so that the local anesthetic property of the acid will be had upon the soft tissue throughout the diseased tract. The warm water in itself is soothing, quieting, to a certain extent, to the inflamed tissue. In a half glass of water, say, you may place from three to four drops of 95 per cent carbolic acid for this purpose. This solution, forced through, thoroughly dilutes the pus and forces it out, so that the tract is left with as little pus present as possible. If you are not satisfied with the forcing of one syringeful through, force the second or the third until the solution comes away comparatively clear in itself.

How can this best be accomplished, perhaps is a point which may do some of you some good if spoken about. I find the best means to be a hypodermic syringe, one which is strong and which will stand considerable pressure. The points should be flexible; gold or platinum are a great deal better than steel; steel is so liable to break if a little lateral pressure is imparted to the instrument while it is imbedded firmly in the root-canal. The point is placed in the canal and soft base-plate gutta-percha, or any of the preparations of gutta-percha stopping, should be packed tightly into the cavity about it; or a little strip of vulcanite rubber wound tightly about the syringe and then pressed firmly into the cavity, serves the purpose very nicely. Thus you will be able to force the medicine through the tract if you can force it through with anything. This done you should follow it with 3 per cent pyrozone or peroxide of hydrogen. There may be still a little pus remaining somewhere throughout the tract, and there is no agent that will destroy it any better than this, or any more effectually. That done and the canal dried, there are different agents which may be placed in the root-canal as a future dressing. One of them is "1-2-3," which, as I have already told you, is indicated everywhere in connection with these treatment cases. Another agent which may be used in this connection is oil of bay. Another oil which may be used is cajuput. We have not had much to say about that, but it is a good agent; it is effectual; it is non-irritating. But of all these agents that are indicated in such a case, oil of cloves is one of the best. Whatever agent is selected for the purpose should be placed in on a thread of cotton, the case sealed and the patient dismissed for a week, as a rule. If the case does well it may rest to good advantage for at least two weeks. And if, in connection with this severe form of acute abscess, you have thoroughly executed all parts of the treating process, as indicated, it will heal with very little trouble. As a general thing the second time you see the patient there will be no pus. Mind you, if you have been thorough in all the details of treating thus far. If you have not been thorough you may expect to find most any condition present. Thoroughness is one of the most essential factors in connection with all your work; close attention to the minute details connected with every operation is of the utmost importance.

If the details are carefully cared for the cases in the aggregate will need no attention. Please remember that all the way through.

Of course, all these cases won't heal as nicely as I have indicated in connection with this one. The formation of pus will continue in connection with some of them; the flow of pus, both through the fistule and through the tooth itself, will continue in connection with some of them, so that your treatment must be continued according to the conditions that present when the case returns at the proper time for treatment.

There is one form of this abscess in which we may use a certain drug to excellent advantage, and there are other conditions in connection with these cases where it should not be used. The drug is 95 per cent carbolic acid. These cases of acute formation, where the pus has burrowed straight through the tissues and has not spread laterally to any extent, but formed a small straight opening from the apex to the surface of the gum tissue, and thus discharged, carbolic acid, oftentimes, is a most excellent agent to use, after having cleansed the pus from the tract as thoroughly as possible by the use of these other agents. You will remember, some of you, that carbolic acid is not a positive permanent antiseptic in itself. It prevents development of bacteria for a certain period of time, after which they develop in the large majority of plants made. The length of time which the plants are prohibited from developing by this agent seems to be in direct ratio to the amount of the drug used in the culture media. But it has some action on the soft parts, stimulating them and exciting a cellular activity throughout the diseased tract that none of the other agents accomplish, so that in some cases it is an excellent agent to use.

Let me tell you how to use carbolic acid in this connection, in case you wish to at any time. You must not use this drug with the syringe, as you do the others, because it would escape at the opening of the fistule and spread all over the soft parts and burn them, form an eschar, destroy the tissue. The canal should be filled with the liquid as well as may be. If it be a lower tooth that you are dealing with you can pass the liquid into the cavity with the pliers. Pass the point of the pliers into the bottle, forcing the points together; the opening above fills with the acid; you pass that to the cavity and open the pliers and the cavity is filled at once. If it be an upper tooth use cotton on a smooth broach, saturate it with the drug and pump it into the canal as thoroughly as possible. The lip must be reflected so that the fistulous opening is exposed clearly to view. Have a napkin, absorbent cotton or bibulous paper ready, so that if a quantity of the acid should escape you can absorb it at once. Have your glycerine bottle open and ready for instant use; in case an excess of the acid escapes, wipe it away and apply the glycerine to the tissue as thoroughly as possible. The glycerine antidotes the effect of the acid. The forcing of the acid through is perhaps more thoroughly and at the same time safely done by the following means: A cone-shaped piece of vulcanite rubber, cut so that it comfortably fills the bulbous portion of the pulp-chamber and projects into the cavity. Then with a smooth-end instrument—large root-canal plugger or amalgam burnisher—you exert gentle, constant pressure upon the rubber and the acid in turn will be forced throughout the tract, if the opening is free, and the instant you notice the tissues begin to whiten about the external opening remove the pressure.

SIXTEENTH LECTURE.

Alveolar Abscess—Continued.

Pus in connection with these cases of acute abscess has a habit, when it breaks through the alveolar plate, of burrowing under the soft parts in different ways. The manner of burrowing under the soft tissues, which we considered the other morning, is the one, as I told you, that occurs more frequently than any other, passing directly into the soft parts underneath the gum and forming a rounded, fluctuating tumor. You see represented in this picture (indicating) another method of burrowing under the soft parts. Instead of passing directly into the substance of the soft tissues and forming a rounded, fluctuating tumor, as in the first case, it has spread laterally between the periosteum and the alveolar plate of bone, virtually stripping the periosteum from the surface of the bone, lifting it away, and in such cases as this, instead of the pus under the soft parts forming that rounded, fluctuating tumor, there will be a flat, soft condition of the parts spreading over a considerable area of tissue. Instead of being rounded out, the pus accumulates as indicated in this picture (indicating), so that upon pressure with the finger you feel this flat, soft surface. When pus takes this course, lifting the periosteum from the bone, it will, if neglected, continue burrowing until the pus discharges about the neck of the tooth; and when neglected there are liable to result seriously.

You remember that the periosteum is the tissue which furnishes nourishment to bone. This is the chief office of periosteal tissue throughout the entire system (after the developmental process)—to nourish bone, keeping it alive and in a healthy condition—and bone tissue in any part of the body when robbed of its periosteum has only one course left, and that is to die—become necrosed. So, in case of abscess, as represented by this picture (indicating), if it is not attended to at once, and properly, but allowed to take its course and become chronic, the periosteum becomes in time diseased and destroyed, is lifted away from that bone tissue, and the bone will die; it has nothing else to do. So that I repeat, if these cases are not attended to at once, just as soon as this condition is recognized, the entire labial or buccal plate of bone (if the abscess is on that surface) is liable to be destroyed, exposing the roots of the teeth.

You will remember, no doubt, some of you, a case described to you by Dr. Black which occurred in his own practice some years ago, and this is of so much importance I will take the liberty to repeat the conditions connected with that case, because I feel that I cannot impress the importance of this upon your minds too firmly. In doing work for a lady patient—considerable filling of the teeth—he discovered that the pulp was dead in one of the upper lateral incisors. He opened into it and made a treatment, telling the lady to return in two or three days, and if there was any trouble following the treatment to come immediately. The time went by and the patient did not return. Two weeks' time went by before he heard anything from her. He happened to meet some of the people from her section and they told him that the lady was very ill, seriously ill. The family physician was treating her for erysipelas of the face. Of course, Dr. Black knew at once, or felt positive that he knew, what the trouble was. Instead of it being a case of erysipelas the pus had formed in connection with that tooth, burrowed through the parts into the soft tissues, and it had taken the course represented by this picture (indicating), so that anyone not perfectly familiar with the conditions about the mouth, in connection with the teeth, would quite naturally mistake that condition—the swelling of the soft parts about the face generally, the inflamed condition, etc.—for a case of erysipelas, as that physician did. Not only he had made this mistake, but many other physicians have made the same mistake. Dr. Black told them to bring the lady into his office just as soon as she could possibly be moved, which they did within two or three days' time. And he found the pus had not only burrowed in this manner opposite that one tooth, but had spread laterally and included five other teeth, virtually lifting the periosteum from the bone, and the bone was becoming necrosed, so that in the course of a few days more it became necessary for him to remove the entire labial and buccal plates (for it included the bicuspid teeth) of bone from the roots of those teeth, leaving them entirely bare to the apex. He cared for the case and had the satisfaction, in the course of time, of seeing those plates of bone reproduced over the roots, so that the case turned out very nicely.

I have had under my care during the past summer a case similar to this one, connected with an upper central incisor, but the trouble was gotten under control before the spreading of the pus extended to anything like the extent of the case just cited. Only two teeth were involved and the plate of bone became necrosed and had to be removed about two-thirds the distance to the end of the roots, and at the present time, to all appearances, these plates of bone have been reproduced and the trouble has healed over nicely.

In each of these cases, Dr. Black and I were both fortunate in seeing them before the periosteum had been destroyed. Had they gone on until that tissue became involved in the suppurative process and had been destroyed, it would have been impossible for a reproduction of those plates of bone, but having been treated properly before the destruction of the periosteum, the plates of bone have since been reproduced. So that you see in connection with this form of abscess it is necessary that we give it our strictest and most energetic care. Whenever it is discovered by you that pus is burrowing in this manner, never wait, under any condition, for it to effect an opening itself, even though you are able to discover the pus only at a considerable depth in the tissues. Use your lance at once, open through the tissues so as to allow the pus to escape, thus stopping the lateral spreading and lifting of the periosteum from the bone. The opening once made, the treatment of these cases is in no wise different from the others, the treatment of which we have considered. Only remember the importance of prompt action and the conditions which may result if you neglect to give attention to it.

We may as well call your attention to the burrowing of pus in this case, while we have the picture here (indicating). This is a lower incisor tooth. You see the pus has burrowed in connection with that abscess in precisely the same manner as in the one just considered, and calls for the same prompt attention that the other case does. In this picture the pus, instead of burrowing through the alveolar plate of bone and passing out at once into the soft tissues, has worked its way along down the peridental membrane, which is represented by this dark line (indicating), between the alveolus and the root of the tooth. The peridental membrane is gradually destroyed and the pus burrows along down the side of the root in that way and discharges at the gingivus. This, also, is a serious complication of affairs, and, happily, you see these cases very seldom. They occur much less frequently than do the other two forms. Whenever you do find pus discharging in this manner from an alveolar abscess there will nearly always be simply a narrow pocket extending from the gingivus to the end of the root, so that a suitably sized instrument may be passed along that pocket to the end of the root, and you are very liable to mistake cases of this kind for pockets connected with pyorrhea alveolaris, so-called, not thinking that there is an actual abscess at the end of the root. And in your work about the mouth, in connection with these cases, let me call your attention to this caution, always well to be observed. Whenever you find a pocket of this kind, a narrow one, pus flowing from it, maybe slowly, maybe considerably, so that you are able to pass a narrow, slender instrument along to the end of the root, remember that it may be an alveolar abscess, and at once institute a careful, thorough investigation to determine whether it is an abscess or whether it is simply a case of phagedenic pericementitis. This remembered, may save you a whole lot of time in the way of treating a pyorrhea case, as you suppose, when, should you open into the tooth and treat for the abscess which is there you would likely cure it in a very short time.

I want to say just a few words more on this subject of diagnosis. You remember some time ago I referred incidentally to the importance of a careful, correct diagnosis of these troubles. And the force of that reference, I trust, has already been firmly fixed upon your minds by the citation of the case which Dr. Black had to deal with, which the physician diagnosed as erysipelas of the face, instead of alveolar abscess; and in a lesser degree the one which I have taken care of. But I want to tell you about a much more serious case which occurred in this city during the past year. A practitioner of considerable prominence on the West Side, one who enjoys a good, lucrative practice, devitalized the pulp of a tooth, and after removing the paste, instead of treating and sealing, as we think is the proper method, left the cavity open, placing nothing in the tooth, to rest for a week or ten days until the sensitiveness, etc., subsided, so he could remove the pulp tissue. The case went along and in about ten days' time suppuration took place in the apical space and went on burrowing through the bone underneath the soft tissues, and spread in a lateral direction—in all directions. It lifted the tissues from the bone in all directions, and that, too, to a very great extent.

Whenever the pus burrows in this manner there is generally another form of micro-organism mixed up in the pus formation—that of the streptococcus variety—the streptococcus pyogenes aureus. You will remember we referred to that form as causing diffuse, purulent infiltration of the tissues, pus forming rapidly and spreading rapidly in all directions. The pus in this case was examined and that form of micro-organisms was found to predominate. The young man, who was a promising young lawyer in this city, became dissatisfied with that treatment and had an idea that he had not been properly dealt with. He went to his physician about it, and he, having so much confidence in the dentist, told the young man that he must be mistaken, and that the treatment was very likely all right. But the case resembled a form of erysipelas of the face and the physician began treating it for erysipelas of the face. He treated it for some time without satisfactory results; then he called in two other prominent dentists of the city for consultation; one of them pronounced it erysipelas and the other said it was simply a case of alveolar abscess. But the physician's judgment and the judgment of the other dentist predominated, and they continued to treat it as erysipelas. Septicemia—blood poisoning finally set in and the young man to-day is in his grave. Whereas, had the trouble been correctly diagnosed and properly cared for such a lamentable termination could not have taken place. So you see what was said regarding this question of correct diagnosis was not idle talk and I repeat once more, by way of emphasis, that in my judgment it is one of the most important phases of our work to be able to correctly diagnose these difficulties, and sometimes it is not an easy matter. So please be on your guard constantly in this connection.

I will call your attention, while the picture is here, to the burrowing of the pus in this case (indicating). This represents an upper incisor. Instead of the pus breaking through the plate of bone and burrowing out under the labial side, you see it has burrowed toward the palatal surface and through that thick portion of bone, spreading under the soft tissues on the palate and lifting the periosteum from the bone. Whenever that condition is found the treatment must be just as energetic and thorough as in the other case; and the treatment of this is practically no different from the treatment of the other form.

If these acute forms of abscess are neglected, are not cared for, the pus finds an external opening through a destruction of the tissues, and in the majority of instances it will burrow through the soft parts and discharge underneath the lip or the cheek, as represented in these pictures (indicating). As soon as the pus breaks through and discharges the swelling of the parts subsides, the inflammation passes away and the case continues and becomes chronic. Chronic alveolar abscess, as we use the expression, simply means a case in which the pus is discharging, in which the inflammation in all of the parts has subsided, and, so far as the tissues in themselves are concerned, they have returned to a normal healthy state; but the pus continues to discharge through this small fistule (indicating).

The treatment of chronic abscess will vary almost as much as the individuals vary that come to you for treatment. Once more the thought that your treatment in connection with these cases must be suited to the individual case. But one, as represented here (indicating), of recent formation, not one of years' standing, will require very little treatment, little more than that which the acute form requires and which we have passed over. It is necessary that all the pus throughout the diseased tract be carried away as thoroughly as possible by flushing the diseased tract, first with carbolized tepid water —this being as good as anything—and then forcing some medicinal agent through, such as pyrozone, until it comes out clear from the opening of the soft parts, and the placing in the canal of a non-irritating antiseptic. And if these previous steps in the treating process have been thoroughly done the case will heal with very little difficulty. And after you have done this, if the fistule seems to be healing, if there seems to be no more pus formation, no generation of gases, but the diseased parts are doing as well as they can, seemingly, do not be in haste to disturb them. Do not change the dressing too frequently; it is not necessary, and with each change of dressing, with each subsequent treatment there is likely to be more or less additional irritation to the diseased parts, which simply postpones their healing for a time. A dressing in a case like this may rest a full week at first. If everything, seemingly, is doing well it may rest two weeks to advantage. Of course, if there is much generation of gases, if there is considerable odor all through the parts at first, it is necessary to treat more frequently. We have now in our infirmary practice two or three cases of abscess. We saw them yesterday afternoon. One was a putrescent pulp to start with, where the odor in the beginning was intense; it seemingly had completely saturated the tooth structure, and every time it was treated (and it has now been treated three or four times) there is considerable odor; it is persistent. Such cases as these require more frequent treatment. The medicine must be kept fresh, so as to overcome that diseased condition. But where this does not exist to begin with, where nothing is indicated except a thorough cleansing of the parts, Nature will heal the case if left to itself, very readily. So do not overtreat these cases. Do not repeat your treatments too frequently.

In a case of chronic alveolar abscess, as represented in this picture (indicating), of years' standing, where the flow of pus has become more or less thin, watery, purulent, odor connected with it, and does not yield readily to this thorough treatment, as outlined, but the pus continues to flow, you may reasonably expect to find complications connected with the case such as we have already cited—serumal deposits on the end of the root; carious surfaces of bone throughout the diseased tract. These, of course, call for the form of treatment necessary to remove the complications.

While we are thinking on this point of overtreatment let me refer to one picture here, so as to impress more firmly upon your minds the force of the statement made in that connection. You see the abscess has formed in connection with a lower incisor (indicating), and instead of breaking through the thin plate of bone it has burrowed straight down through the body of bone, through the soft parts, and the pus is discharging underneath the chin. To impress more thoroughly upon your minds the idea of treatment in these cases, and the fact that it is possible to overtreat them, let me recall another case which came under the care of Dr. Black, and which some of you have already heard about, but there are a great many of you who have not heard it, hence, I consider it worth the while to repeat. A lady living in the country had trouble as indicated here (indicating). The abscess formed in connection with a lower incisor and burrowed down through the bone and discharged under the chin. The physician was treating that for some sort of trouble, probably cancer of the bone, treating through the fistule and trying to heal it. He came to the city and consulted Dr. Black and asked him if it were possible that pus could discharge under the chin in such a manner and be connected with the teeth. Upon being assured that it was quite possible, he asked for further information as to what he would do by way of properly diagnosing the case, and the doctor told him to test the teeth along there with heat and cold and see if he found any response to the thermal changes. If any tooth did not respond, in all probability the pulp was dead in that tooth, and to examine carefully the crowns of the teeth for discoloration. He went back and applied the test and found one tooth which did look somewhat discolored and which did not respond to the test, and, of course, came to the conclusion that that was the tooth connected with the abscess. Calling in a local dentist, they drilled into the tooth and treated a few times, and as the abscess did not heal they extracted the tooth. They took a long, slender needle and attached a string to it and attached a ball of cotton to the string, saturated that with carbolic acid, passed the needle in the opening and dragged the swab of cotton through the entire tract (laughter). They instructed the patient that it was a very serious case and that she must return every day to the office for treatment until it was cured. Every day for a week or so they went through the same process. Of course, it did not heal—it could not. If any granulation tissue formed they destroyed it. A severe snowstorm came up, the roads became blocked and the lady could not go to town for a few days. She had noticed that the opening underneath the chin had healed over in the meantime and she began to be worried. She hastened to town as soon as she could get there, and sure enough, the case was closed; they could not get their string, etc., through the tract (laughter), and they did not, even then, understand the condition of things, but immediately went in and consulted Dr. Black to find out what the trouble was. Of course, the case had simply healed as the storm came, probably from Providential direction, to save the lady, and she was cured. So you see it is possible to overtreat these conditions, and I want to repeat just once more this thought—that in dealing with these cases, and all forms of these diseased conditions, let your first treatment be thorough. Of course, the inflammation and the swelling and the tenderness of the parts, and all that, may be so severe in some cases that you cannot do anything at the first sitting more than to open the abscess and let the pus discharge. But as the swelling, etc., is reduced so that you can treat thoroughly, *let the first steps in your treating process be thorough,* every part of it; cleanse the parts thoroughly, place your antiseptic thoroughly, and if you do this you do not need to worry, in the vast majority of cases, about the result, for they will heal if given half a chance.

I want to call your attention, now, to the various manners or modes of the burrowing of pus in connection with these alveolar abscesses. The most ordinary ways in which the pus burrows through the parts, we have already referred to. But you see represented here (indicating) an abscess in connection with a lower incisor tooth, in which the pus has burrowed through the bone labially, and instead of forming a tumorlike swelling underneath the parts and opening into the mouth, the pus has followed the muscles down close to the bone just outside the alveolar plate, and worked its way down underneath the chin and is discharging at that point. You will not see very many cases like this, but once in a while they occur. In the treatment of a case of this kind it sometimes seems well to cut off the flow of pus underneath the chin and to make an opening into the mouth and divert the direction in which the pus is discharging. That can be done with very little trouble, so that the remaining portion of this fistule will be healed and the pus will discharge into the mouth, through which opening you will be able to treat the case more easily, and possibly more thoroughly. Simply passing the knife through the parts, cutting that tissue off (indicating), and at the same time making the opening here (indicating). Cleanse this tract thoroughly and it will heal very readily. I have had occasion to do that in my practice but twice, in each instance being successful. You may live a lifetime and not come in contact with a case of abscess in which the pus is discharging as represented here, and it may not always be necessary to divert the discharge of the pus in order to effect a cure. If you are able to force your medicinal agents through without difficulty you can cleanse as thoroughly through the entire tract as any other way, but oftentimes you cannot do that successfully.

There is a little point here in connection with keeping the opening through the soft parts free for a few days to facilitate treatment. Whenever you open an abscess with the lance and the pus discharges, if something is not placed in that opening the soft parts will heal very quickly after the pus has escaped. Take a thread of cotton saturated with carbolic acid, the excess of which is absorbed, and pass it into the opening into the pus cavity and leave it there. You can do that very handily with a large broach or a small root-canal plugger. Wind the cotton about the point and pass it in the opening, sliding the cotton off of the instrument. That will effectually prevent the opening which you have made in the soft parts, from healing.

Here is a picture (indicating), representing a discharge of pus from an alveolar abscess into the naris. The abscess formed in connection with an upper incisor tooth and the pus burrowed straight up through the body of the bone and discharged into the naris. In connection with cases of this kind, especially where the pus opens farther back in the nasal cavity, as it sometimes does, and there is a constant dripping of pus into the back part of the throat, physicians frequently have mistaken this condition for some form of catarrh; another instance of incorrect diagnosis. And cases have been known, lots of them, where physicians have continued to treat them for months, and even years, for catarrh, whereas, it was simply the discharge of pus from an alveolar abscess.

Here is the picture of an abscess (indicating), in connection with an upper molar tooth in which the pus has burrowed out through the tissues and is escaping on the face, instead of burrowing down and opening into the mouth.

This picture (indicating) represents the scar that is left on the face from such an abscess. This always leaves an ugly scar on the cheek—a contraction of the soft parts. By passing the lance in underneath the cheek and cutting off that tract of cicatricial tissue which draws the surface of the cheek in, and raising it out and allowing it to heal, will in a very great measure correct the deformity which is left on the surface of the face.

Here you see represented (indicating) the opening on the surface of the face caused by the discharge of pus.

Here (indicating) is represented the discharge of pus into the antral cavity from an abscess connected with a molar tooth, and this is by no means an infrequent occurrence with bicuspid and molar teeth, the roots of which oftentimes extend very close to the floor of the antral cavity, and in many instances they actually protrude into the bottom of the antral cavity, so that the soft tissues and the thin layer of bone covering over the apex of the root are raised up into the antral cavity. In such cases as these, if an abscess develops, it is almost certain to discharge into the antral cavity. The abscess in this case (indicating) has extended across from a buccal to the lingual root, connected with both roots and finally burrowed up and discharged into the antral cavity. Conditions of this kind have to be treated for diseased antrum.

SEVENTEENTH LECTURE.

Alveolar Abscess—Concluded.

We will consider this morning the odds and ends in connection with this subject of abscesses. Many little conditions arise in connection with the various cases with which it is well for you to be more or less familiar.

In connection with the chronic forms of abscess, in which pus is discharging through a small fistule, as you see represented in this picture (indicating), oftentimes the opening through the soft parts on the surface of the gum will heal over and remain healed for a few days; the pus reaccumulates in the apical space, pressure is in consequence exerted upon the soft tissues and the opening is again effected and pus discharges, and again it will heal over and thus remain for a few days, repeating this process of healing and opening any length of time if the case is neglected and not treated. In connection with this healing of the soft parts and reaccumulation of pus, reopening and redischarging, especially in connection with some of the lower teeth, we find the pus burrowing farther and farther along the soft parts before the opening is again effected; and, to make a long story short, we sometimes find the pus burrowing along the muscles of the face, down the muscles of the neck and opening and discharging upon the side of the neck.

You will remember such a case related to you last year by Dr. Black, which came under his observation, in which the pus was connected, I believe, with the lower molar tooth. Sometimes after the pus has been discharging upon the surface of the gum, as represented in this picture (indicating), the opening healing for a time and the pus reaccumulating and continuing to burrow a little farther along the soft parts before effecting another opening, and becoming entangled in the fibers of the platysma muscle, extending down the side of the neck until it reaches the point where the muscle passes over the sterno-cleido-mastoid muscle, forming a little ridge, and at that point the pus breaks through the surface. And instead of discharging at that ridge it has been known to burrow still farther down and discharge in the region of the breast. It is rarely ever that you will find abscesses connected with the upper teeth thus burrowing, but occasionally they have been known to do so. Dr. Swain, a prominent dentist of this city, a number of years ago cared for a case in connection with an upper left second molar, the pus from which abscess burrowed through the fibers of the masseter muscle, down through those of the platysma muscle, passing down those of the sterno-cleido-mastoid muscle and opening away down on the chest. But this sort of burrowing in connection with the upper teeth is exceedingly rare. No doubt, occasionally the pus from these abscesses, when thus it burrows, opens internally into the pleural cavity instead of opening externally, and thus gives rise to pyo-thorax. But this occurrence is comparatively rare; such cases have been known, however, where the cause of pyo-thorax was traced to the teeth themselves. So that in your practice in the future you may look for almost any condition of things in connection with these cases of abscess.

In regard to threatened pus discharge upon the face. Whenever the pus is burrowing to a very great extent in the soft tissues, and it seems likely that an opening will be effected externally, there should never be any neglect on your part in connection with the treatment. Let your treatment be prompt, and severe, if necessary. Make an opening on the inside of the mouth with your lance, reach the pus pocket in some way so as to prevent the opening from forming on the surface of the face. The reasons for this you well know. And in this connection never advise the use of, nor permit your patients to use hot fomentations or poultices of any character upon the outer part of the face. If hot applications are to be made anywhere, let the patient use them, by way of hot water or something of that sort, in the mouth. You know it is a well-known principle, which we have referred to several times, that pus burrows in the tissues in the direction of the least resistance. The action of these hot applications is simply to loosen the cellular structure of the tissue; the moisture being absorbed into the tissue the cellular structure is thereby loosened, thus making it easier for the pus to burrow in the tissue where that condition is brought about.

This is the manner in which poultices, in general, "draw," as is the common expression as to their action. You apply a poultice to a boil or anything of that sort to "draw" the pus to the surface; it simply softens the tissue, loosens its cellular structure and thus renders it easier for the pus to burrow in that direction.

Oftentimes in the treatment of chronic abscesses, and occasionally in connection with acute abscesses with a fistule, it will be impossible to open through the foramen and force your medicinal agents through the diseased tract. Of course, you should exert every effort in your power, use every known means to effect this opening through the foramen, without mutilating the natural structure of the tissue any more than possible. But after you have used every means that you know of and fail to force the remedies through the entire diseased tract, before resorting to any more heroic form of treatment you should try diligently to heal the case by treating the root-canal, and also by cleansing the fistule from the external opening. Sometimes you can effect a cure in this way with little trouble. With a blunt pointed hypodermic syringe passed into the fistule from the external opening, down to its very extremity, you thus cleanse it with your medicinal agents. Treat thoroughly in this way before resorting to anything more serious by way of an operation.

It is often desirable, frequently necessary, that you use agents in connection with the treatment of these chronic abscesses, especially, that are very stimulating, irritating to the tissues throughout the diseased tract. The use of the milder agents does not accomplish the desired result; the recuperative powers of the individual are not what they should be, the patient is not strong physically, the cellular activity is not up to the standard. The non-irritating agents do not effect that cellular activity throughout the diseased tract which seems necessary in order to effect a cure. I have mentioned one or two agents; one, especially, that may be used in this connection. Aromatic sulphuric acid is, perhaps, the most powerful that is at all desirable to use in these conditions. If this agent is to be forced through the entire tract so that it comes in contact with the soft tissue it should not be used full strength. Aromatic sulphuric acid, as you know, is simply composed of 20 per cent sulphuric acid, 80 per cent alcohol, and enough cinnamon and ginger to impart to it its characteristic aroma. And 20 per cent sulphuric acid is a pretty strong agent to deal with in connection with soft tissue. So dilute aromatic sulphuric acid, as a general thing, two or three times. Thus diluted it may be forced through the entire tract, and if a considerable quantity does come in contact with the soft tissue, if immediately wiped away it will do no harm; but if an accumulation is permitted to remain in contact with the soft tissues it will cause more or less of an eschar to form and result in the destruction of the surface of the tissue. It is never necessary in using these agents to use an excess of them; you must be on your guard and use them carefully, although thoroughly. If an excess of this acid should pass out onto the soft tissue glycerine is as good an agent as you can use to counteract its effect, the same as in the use of carbolic acid. There are other agents which may be used possibly with equally good effect; I mention this one because it is one of the cleanest and one which you will be most likely to have in your case and which is as efficient as any. Any of the ordinary fixed oils will counteract the effect of these agents on the soft parts. Soap rubbed thoroughly into the soft tissue will also counteract their effect very well.

While we are speaking of the use of carbolic acid in connection with the use of these other agents I want to call your attention to another point. Whenever the pus in these acute abscesses has burrowed under the soft parts to a considerable extent, so that a large surface area of the soft tissue is thus exposed to the action of whatever medicinal agent may be used, carbolic acid should never be used. Please remember that statement. Never force carbolic acid through these diseased tracts where it will come in contact with such a large surface area of tissue as is represented in this picture (indicating), simply because of the destruction of tissue which will thereby result, and also to avoid local carbolic acid poisoning, which oftentimes occasions considerable trouble in the after treatment; it is not a nice thing to deal with. So use that only in cases from which the pus is discharging through a small straight opening, or a narrow fistule leading from the apex of the root to the surface of the soft parts, where it does not come in contact with any considerable extent of soft tissue. And it does not need to be used in these latter cases very frequently, but occasionally it is a desirable agent and results in exciting a cellular activity throughout the parts which the milder agents fail to do, just the same as does aromatic sulphuric acid, and just the same as will another agent which may be used to decided advantage in some of these cases, and that is oil of cassia. Oil of cassia, you know, we do not use in the root-canals of teeth where there is no abscess, where there is no opening through to the external surface. It should never be used in the treatment of these cases where it is to be confined any length of time in contact with the soft parts. Good strong cassia water in connection with the treatment of these fistulous abscesses oftentimes is a splendid agent, and it may be forced through in full strength, for that matter, if deemed advisable. It does not remain in contact with the soft parts a sufficient length of time to cause trouble, but is there long enough to excite that cellular activity throughout the diseased tract which is so desirable and oftentimes so necessary to effect a cure.

There is another agent which is oftentimes useful in these chronic forms of fistulous abscesses, and that is oil of myrtol. Myrtol is not so potent an antiseptic as these other agents. It is, however, quite irritating to the soft parts. An application of myrtol for 24 hours resulted in decided evidence of blister formation, although blister did not form; but for two or three days succeeding the removal of the agent a superficial layer of the skin would peel off, was destroyed by the agent, and there was more or less swelling in connection with the part, inflammation, also, showing that while it is not nearly so irritating as these other agents, it is considerably so.

Occasionally we come in contact with abscesses with fistulous openings of the chronic variety in which there is constantly—not really pain, but a disagreeable sensation throughout the entire part. Occasionally the patient will complain of an itching sensation. In such cases as these strong myrtol water, or even myrtol in full strength, seems to act better than any of the other agents in controlling these disagreeable manifestations that are constantly taking place.

There is another little condition, a local affair, which sometimes occurs about the gum margins, and which you may in some instances mistake for alveolar abscess, and that is the formation of what we call gum boils. There will be a cavity formed in the tooth near the margin of the gum; the roughened edges of the cavity are continually irritating the soft parts, or there may be an accumulation of tartar underneath the margin of the gum; or in the setting of a crown there may be a small portion of cement forced down under the soft tissue, and it remains there an irritant, and from these and other causes the soft parts become inflamed, and suppurate, pus forms in the tissue near the margin of the gum. Sometimes the pus formation will be slight; in other cases it will be considerable, so that the tumor-like swelling in the soft tissue occasioned by the accumulation of pus will be large. It will often work down and occupy a position near the apex of the root, but more frequently is found in the region of the margin of the gum, and unless you are familiar with the condition of affairs you are very likely in some cases to mistake it for alveolar abscess. The only treatment indicated in connection with a trouble of this sort is a thorough discharge of the pus, a thorough cleansing with some antiseptic agent—it does not matter much what one, so long as the pus pocket is thoroughly cleansed—which is best used with the hypodermic syringe. And then a removal of the cause of the irritation, whatever it may be. If it is a cavity, it should be attended to; if an accumulation of tartar, that should be removed; if an impaction of any foreign material, that should also be removed.

It is generally an easy matter to diagnose correctly between this local trouble and alveolar abscess. If the pulp is not dead there will be no discoloration of the crown of the tooth; if it is, in all probability there will be. There may be looseness of the tooth even though the pulp is alive, because of the inflammation of the gum tissue and the inflammation having extended to the peridental membrane, which it often does. I have seen the teeth in this condition very loose; unless it is a severe case there will not be much looseness. The application of heat and cold will quite definitely determine whether the pulp is alive or dead. So that you need have no trouble in diagnosing these cases.

There is another complication not yet mentioned that sometimes occurs in connection with the treatment of abscess, and also in connection with the treatment of cases of putrescent pulp, and this is very likely to occur especially when you have used the burr or the drill in your endeavor to effect a better opening throughout the root-canal. You are dealing with a fine canal and you want it larger, and you resort to the use of the burr or the drill in your engine, sometimes a hand-drill, and the root happens to be a thin, flat, constricted one so that the walls from the canal proper to the external surface are very thin, and the opening, instead of following the canal as you desired, passes through the side of the root. This forms a very ugly complication, oftentimes, in dealing with these cases, one of which results in inflammation of the peridental membrane, and oftentimes becomes chronic through the forcing of infectious matter into the soft tissues about the root. The inflammation excited is severe, and is one of the most stubborn complications to deal with, oftentimes. You treat with these essential oils which have been told you are soothing and quieting to inflamed soft tissue, such as oil of cloves, being the best one of this class, and you treat for a long time and diligently without seemingly any headway; the inflammation in the soft parts about the root persists, the tooth remains tender to pressure. What shall be done? Sometimes you can't do anything. No matter what form of treatment you resort to in some cases the inflammation persists, and when it does persist in this way there is only one thing to be done, but before that is resorted to it is well to test the case because occasionally they will turn out all right. Oil of cloves and aristol mixed to a thin paste and packed into the root-canal, or a liberal quantity of it passed into the root-canal on a thread of cotton will act perhaps better than any other agent or combination of agents in connection with these cases, that you can use. In connection with the action of cloves there seems to be a soothing, quieting effect imparted by the aristol which frequently will control the inflammation and cause the parts to return to a normal, healthy condition.

After trying all of the agents that are proper to be used, and failing, cleanse the canal as thoroughly as you can, dry it as thoroughly as you can, fill it with gutta-percha and give it a trial. Sometimes, after a few days or a week of painful existence, the inflammation will subside, and it will turn out all right and be comfortable forever after. But where they have acted thus stubbornly all the way through, the chances are that you will have to extract the tooth before you get through with the case. Often where the inflammation in these cases at first is not very great, it yields very nicely to a little local treatment. In such cases as those where other treatment in the canal is necessary, you should close over the opening into the soft parts by flowing chloro-percha over it, if you can possibly reach it and accomplish this result, and if the opening is near the pulp-chamber where you can work handily, pack a little softened gutta-percha stopping over the opening and do not disturb it in your future treatment, and proceed with the treatment exactly as you otherwise would. But never in this connection pack the gutta-percha into the foramen.

I want to tell you a little incident now that occurred out West at a dental meeting some years ago, a form of treatment that was advocated by one of the oldest and, hitherto, most respected practitioners in the dental profession; a gentleman living in Cincinnati. A discussion of the treatment of pulpless teeth was in progress, and while the old gentleman agreed that it was not well to use such agents as oil of cassia, cinnamon, etc., because of their irritating effect on the soft parts, yet, he could not discard the agent; he wanted to use it because it was such an efficient antiseptic; he wanted to fix up the case in some way so it would be comparatively safe to use it. And he made this statement—that in connection with cases of putrescent pulp he mechanically removed the debris from the root-canal as thoroughly as possible, and then took gutta-percha stopping and passed it to the apex and sealed the foraminal opening completely (to prevent the cassia from passing through and irritating the tissues in the apical space), after which he used his cassia and went on with the treatment of the case. (Laughter.) This is no fairy story, on my part, although the manner of treatment advocated seems very much like the "fairy story" variety.

In the packing of this stopping for the sealing of these lateral openings through the side of the root, be careful that you do not pack it into the foraminal opening. That is liable to occur in some cases.

There is another condition—not properly speaking a complication in connection with these cases of abscess, but more properly a result of the attempt on the part of the tissues to heal after the case has been supposedly treated thoroughly and the root-canal filled. This will occur very frequently in connection with the treatment of blind abscesses, and also chronic abscesses which formerly have had fistulous openings. After the canal is filled there will occur a little swelling opposite the apex of the root, an enlargement of the tissue. That swelling sometimes will be soft, sometimes it will be quite hard; sometimes it will be slightly tender, sometimes very tender, and sometimes not tender to pressure. It will be possible to get the sensation of fluctuation upon digital examination of this little swelling as though there were an accumulation of liquid of some nature in the part, which oftentimes is the case, serum, and then again, there is no accumulation of liquid. The swelling is occasioned for the most part by the cicatricial tissue which is formed there in its endeavor to heal the former opening, the tissue becoming enlarged, puffed up, and sometimes we are apt to mistake this little swelling, when noticed, for a reaccumulation of pus, and proceed to treat for this trouble. But before opening into these little swellings, when they thus occur, treat them locally, and oftentimes you will cause them to disappear entirely, for in nine cases out of ten is not a reaccumulation of pus, but simply was caused as indicated. Treat them with tincture of iodine, tincture of aconite and iodine; paint the part thoroughly and the absorption of these agents into the soft parts will cause them to disappear frequently, but not always. Sometimes they will persist, and when they do, they are liable to become more or less tender to pressure and begin to occasion inconvenience and annoyance to the patient. By radical means you can almost invariably cause them to disappear, no matter how long they have been there or how annoying they have become to the patient. Pass the blade of the lance right through the tissue and into the swelling itself. If there be any accumulation of fluid it will thus escape. Then with the hypodermic syringe force a drop of the tincture of iodine right into the swelling itself. That will cause a very great amount of irritation; it will induce inflammation, sometimes quite severe, and make the parts about the swelling tender and sore for a few days' time, but it will hardly ever fail to cause the swelling to disappear in the course of a few days.

Another difficulty which often occurs—not often, I trust, with you—but occasionally does occur in the treatment of these cases of pulpless teeth, or abscesses, or simple devitalization cases, is the breaking of your broach and a portion of it remaining in the root-canal; and when the fine point of one of your barbed broaches breaks off and is pressed into the canal near the foramen its removal is indeed a difficult matter, and sometimes you can't remove it. If you are dealing with a root that is round, in which the canal is large and straight through the center so that you know there is a considerable extent of dentine tissue about the canal all the way to the end of the root, sometimes you can by enlarging the canal with the drill reach the metal, and with a fine slender-pointed pair of nippers remove it. If you resort to this manner of enlarging the canals you must exercise all due care not to cut through the side of the root, and never undertake that except you are sure that the root is not flattened so that you will be very likely to pass through the side of it. If you cannot reach the piece of broach with the nippers, occasionally you can remove it by taking a wisp of cotton and packing it into the canal about the end of the broach; then with a burr in the engine passed into the cotton and run rapidly so that the cotton is twisted about the burr and in turn about the broach. Sometimes the broach will come away in that manner and sometimes it won't. If you have thus far failed in your efforts to remove the broach, it is well to resort to the use of iodine and try and dissolve it. Oftentimes you can do this very nicely. If dealing with a tooth in the anterior part of the mouth the use of iodine is not desirable, but where the cavity in the crown of the tooth is large and the entrance to the pulp-chamber proper is large, you can use it sometimes without permitting it to come into contact with the dentine in the crown of the tooth. Crystals of iodine should be used for this purpose. The canal should always be enlarged as much as possible so that you can place as large a quantity of iodine about the broach as possible. Slightly moisten the iodine so it will dissolve, pack it in the canal, seal the case tightly and let it rest for a day or two. The iodine will often dissolve the iron and you will be able to work through it and effect an opening through the foramen, but occasionally this will fail. Sometime the iodine will act upon the iron, dissolve it, and the iodide of iron largely is formed, and before you open the case this solution becomes hardened and packed into the end of the root, a hard, unyielding mass. You can't work through it with your broach; and it is not desirable, in the majority of cases, to drill through it. Whenever this condition of things takes place, leave it. Iodide of iron will remain there insoluble, it will not waste away, in nature it is antiseptic and it will form as good a permanent sealing for the foramen of the root of that tooth as anything you can place there. So if there is no other complication making it necessary to treat through the part, let that remain as a permanent sealing—remember, only when you can't get through it.

Often upon extracting roots of teeth which have been abscessed there will come away with the end of the root a portion of tissue, enlarged, swollen, the fibers of which are filled with a substance which looks like pus, and is pus. This sac we commonly refer to as the pus sac. This mass of tissue is nothing more or less than the fibers of the peridental membrane which formerly occupied that position in the apical space, and as we shall learn farther on, the fibers of the peridental membrane are imbedded in the bone tissue, right in the substance of the bone, and the action of the pus in absorbing the hard tissue has thus set free the fibers of the peridental membrane. The destruction of the membrane about the root of the tooth is not brought about, in the majority of these cases, as quickly by pus formation and pus burrowing, as is the destruction of the bone itself. Thus the tissue still clings, thus swollen, thus enlarged, thus infiltrated with pus, to the end of the root and comes away with the root, thus forming what we ordinarily term the pus sac in cases of abscess.

EIGHTEENTH LECTURE.

Just as I stated to you some time ago, the pulp tissue does not possess the properties or the elements necessary for self-repair. Once a portion of its structure is destroyed, it is destroyed for all time; it cannot reproduce itself.

Inasmuch as so much interest was aroused the other morning in connection with the subject of capping pulps, I will say a little more about it before leaving the question. It was not my intention to say much regarding the materials or the methods of capping. That properly belongs to another department, although it would not be out of place here somewhat; but especially the condition of the pulp for capping, I wished to consider.

The condition of the pulp for capping should be that of normal, just as nearly as it is possible to place it in that condition. The thought is this—that if a pulp has been diseased, and in your palliative treatment you have partially restored the normal functions of the pulp, partially succeeded in eradicating the disease, it is not in a favorable condition for capping. If this disease has gotten such a foothold that you cannot succeed in wholly subduing it, overcoming it, causing the pulp to return to a perfectly healthy state, you might just as well, and better, in my judgment, devitalize first as last; it is sure to give trouble and die in the course of time. And in this connection comes another thought. If the pulp is perfectly healthy at the time of capping, what is the necessity for the mixture of various medicinal agents with the cement, or other substance used for capping purposes? That thought was mentioned by some. The question was asked if it would not be well to mix hydronaphthol—one drug which was spoken of—or various drugs, with the cement, if cement you use, for capping the pulp. A mixture of a small quantity of these non-irritating antiseptics with the cement cannot be objectionable. They will do no harm and they might result in some beneficial therapeutic action; so there can be no objection to it especially. On the other hand, it is my judgment that it will do very little good. As regards the placing of mixtures, essential oils and powders immediately over the exposure and placing the cement over that, I don't want that done because I think it is never justified, for the reason you will remember that I stated in answer to the question that was asked on that point.

You all know by this time, possibly, I know some of you do, that as large a quantity of an essential oil as can be placed in the root-canal of a tooth on a thread of cotton may, in the course of time, become completely absorbed, taken up, its virtue gone, so that there are no further beneficial effects being imparted to the tissue from the oil. If so large a quantity of oil will pass away, sometimes within two weeks' time, or even less, how long would such a small quantity of any of these agents be apt to persist in that small quantity of cement that is used for pulp capping? Simply this thought, that you may think on these things, reason them out for yourselves.

As regards the use of *mummifying paste*. This idea seems to have gained a foothold in the minds of quite a number of you. It is now being advertised, I believe, by some of our dental supply companies and pushed vigorously.

Mummifying pastes should never be used whenever it is possible in any way to remove the pulp tissue from the root-canal. You will never find it, in my judgment, good practice to leave dried up pulp tissue in the root-canals of teeth, even though these agents might succeed in hardening, in mummifying the pulp tissue and placing it in such a condition that it in itself would never become septic or otherwise bad—and which I do not believe. But what are the conditions about it, inside of the pulp-canal? That is the important phase of the question. That tissue is dried up, is contracted, it does not fill the space of the pulp-chamber and root-canal completely; it does not anywhere near fill it, there is space all about it in the pulp-canal. The foraminal opening is intact and moisture passes into the pulp-canal and degenerates, and the other elements necessary come into the pulp-canal and finally suppuration may occur, just the same as if the pulp tissue had never been mummified. No one can dispute this. So think about these things, think about the conditions all about these parts, and do not be satisfied with concluding that the dried up pulp tissue itself is the only element connected with this sort of practice, because it is the element of least importance. The open space and the other conditions all about it are the ones to be looked to.

There are root-canals, and we have referred to them, in which it is almost impossible to gain an entrance or to work, in any wise satisfactorily, so as to remove the tissue. In such cases, as it has already been said, we simply have to do the best we can. If the mummifying pastes have any virtues whatever, use them in connection with such canals as these. Some one of your number, however, has made the statement that in dealing with such canals as these he succeeds very well, in most instances, in filling them up with the broken points of fine broaches. Possibly this is as good a plan as any. (Laughter.)

But to return to our subject proper. As I have stated, the pain in connection with cases of hyperemic and inflamed pulps is, perhaps in the majority of instances, being manifested in some locality more or less remote from the diseased member. This is true, and especially is it true in connection with the pain from inflamed pulps. You will find this pain being manifested in almost any portion of the head and face. Very frequently it is manifested in the ear; this, seemingly, is a favorite locality for the pain from inflamed pulps. In connection with these cases the patients are more liable to suffer pain at night, suffer what are called nocturnal pains, those occurring principally at night, especially after retiring, and assuming the recumbent position—this may occur, of course, if the patient assumes the recumbent position any time throughout the day, the blood pressure being greater in these parts while in the recumbent position, hence the manifestation of pain at this time.

The causes of inflamed pulps, I think, we have said about enough on. Only to recapitulate very briefly. The vast majority of cases of inflamed pulps are brought about through direct exposure to the irritating effects of the carious process, of micro-organisms themselves passing into the pulp tissue, the ptomaines or waste products formed in the process of decay; these conditions being responsible for the vast majority of cases of inflamed pulps. Of course, it is possible, and oftentimes inflammation of the pulp is brought about from a severe blow upon the crown of the tooth, or upon the application of excessive thermal changes; the irritation passing to the pulp, the hyperemic process following and the inflammatory process immediately following that. Whenever from these causes, the destruction of the pulp is effected in a very short time, as a rule.

Hypertrophy of the Pulp.

You will remember that we have several times made the statement that the pulp tissue cannot swell, which is true so long as there is no external opening leading to the pulp chamber; but the moment a small portion of the pulp is exposed so that there is an external opening it affords the condition necessary, and renders it possible, for the pulp tissue to enlarge. In these cases there is a form of inflammation inaugurated, evidently from a different form of micro-organisms than that concerned in pus formation, for, as we shall see in connection with these cases, suppuration rarely ever takes place. And in connection with these cases of hypertrophied pulps, pulps of extra growth, this inflammatory process is almost always a slow one. The causes which bring it about are not very active, i. e., there is a slow, continued form of irritation from some cause, and the inflammatory process following that is of the same character, not progressing rapidly. This irritation may be brought about by the direct influence of these micro-organisms, or their products, concerned in the carious cavity, or which have gained access as the caries has progressed. It may be brought about, more or less, from the irritating effect of the sharp margins of the cavity itself upon the soft tissue. At any rate, this slow plastic form of inflammation is inaugurated, and the cellular elements of the pulp begin to multiply. The fixed cellular elements lose their identity, divide up and thus greatly multiply and the pulp tissue begins to push itself out of these openings, whether large or small. The pulp thus grows into the cavities. In molar teeth, where almost the entire coronal portion of the dentine has decayed so that there is a large cavity, you will find not infrequently this extra growth of the pulp filling the cavity completely, the outer portion occupying a position almost level with the cusps of the tooth. You will find these growths, as in extent, varying from that which is slight to the extreme, which I have just mentioned. These growths almost invariably are very sensitive, the slightest pressure or irritation of an instrument or any foreign substance causes much pain, and in connection with the process of inflammation, which brings about these extra growths, there is almost from the very beginning of the irritation pain manifested to a greater or less extent, sometimes severe. Sometimes the patient will tell you that he has experienced very little pain in connection with this process, but rarely ever will you find one connected with which there has been no pain.

What shall our treatment be for this condition of affairs? And let me say right here that in connection with this condition you have a pulp that under no circumstances, in my judgment and in the judgment of many individuals whose judgment is worth a thousand-fold more than mine, should be capped. They are not favorable cases for capping, even though the exposure is minute, even though the growth of the pulp is very small. I mention this point especially because in your reading of dental literature, possibly in the future, and especially so in the literature which has been published in the past, you will find many excellent practitioners advocating the capping of these cases where the growth is not very great; cutting away the extra growth, touching the surface of the tissue thus exposed with nitric or chromic acid, so as to stop the hemorrhage, and then capping. I have tried it in some cases and have never succeeded. I know others who have tried it many, many times and have met with failure in almost every instance. So you may set it down as a fixed rule, that it is not wise to undertake to cap pulps under these conditions, no matter how well you are able to reduce the inflammation and stop the pain and seemingly return the tissue to a healthy condition. It is almost certain, in the course of time, to cause trouble and die.

As I stated, these growths are exceedingly sensitive, and it is necessary to get rid of them before applying paste for devitalizing. The sensitiveness can be in a measure controlled by the use of cocaine crystals; placed upon the extra growth they will immediately melt, and then give them time to be absorbed. However, you will find this in connection with these extra growths—that they seemingly resist the absorption of medicinal agents in most instances. This is not a natural growth of tissue, the circulation is not being carried on as it is in the normal pulp, the cellular elements, structural forms of this growth are not what they are in the natural formation of the pulp, so that medicines applied to them are not absorbed in the manner that they are when applied to the normal pulp. Very frequently in your endeavor to allay the sensitiveness so that you can remove this extra growth, with the use of cocaine, you will not be successful, simply because it is not absorbed. Often crystals of carbolic acid may be used successfully, and I have had cases which were so extremely painful upon the slightest touch or pressure, and in connection with which these local applications did no good, where I thought it advisable and did go to the extent of administering gas for the purpose of removing the extra growth, and while the patient is under the influence of the anesthetic remove the root portion as well. With a large, sharp discoid, one which will cover the exposure completely, and with one quick motion sever the connection of the growth at its smallest portion at the bottom of the cavity. The hemorrhage will frequently be severe following this operation. After the hemorrhage has been controlled (and I will speak of how this is best done when we consider the subject of styptics and hemostatics), the application of paste should be made. This will be your invariable treatment of this condition of things.

While we are speaking on this point of the use of paste for devitalizing, there is another condition which I think it well to refer to, because, if I remember correctly, I did not especially refer to it. In connection with suppurated pulps, as you see represented in this picture (indicating), only a small portion of a horn of the pulp has thus far suppurated. Whenever, upon the exposure of a pulp, a small globule of pus passes away, indicating that there is only a small portion of the pulp involved in the process, and if you are not yet certain, pass your broach into the exposure and determine whether the pulp tissue immediately beyond it is living or not; the thought is this—before applying paste you should enlarge the exposure so that the living tissue may be fully exposed, and all of the pus drained away, washed out completely. Unless you do this you leave a particle of pus in there to occupy a position between the paste and the living tissue and the arsenic will not be absorbed through it into the tissue. Your patient returns, you remove the application and you find the pulp just as sensitive as it was before and you do not understand why the paste has failed to act. It is simply because this fluid has prevented it passing into the tissue.

SUPPURATION of the pulp we have sufficiently considered, so that we need not spend more time on it, except this one thought—in connection with the entire process of irritation, hyperemia, inflammation, death and suppuration of the pulp, in the various conditions we have considered we have had those forms in which there is pain being constantly manifested. This thought, now, in regard to pain in connection with these processes. It is possible for the pulp to pass through all these various pathological conditions and processes and pus form without the manifestation of any pain at any stage of the process. These, of course, comparatively speaking, are rare instances, but you will occasionally come in contact with patients who will give a history of no pain.

There is another form of irritation which sometimes takes hold of the pulp tissue and progresses, which is a much lower type than any yet referred to; the progression of the inflammatory process is slow, and the inflammation will begin at a small point in the pulp, which has been exposed or otherwise irritated and progress along its central portion, along the blood vessels, as the suppurative process frequently does, and the tissue all about it will remain in a healthy, normal condition; but gradually this inflammatory process continues and slowly involves more and more tissue, until finally it is all involved in the inflammatory process, and finally dies. No suppuration occurs at any stage of this process. This inflammation is brought about by a form of micro-organisms, as referred to a moment ago, which does not cause suppuration, and the pulp tissue will thus degenerate into a form of connective tissue, the fixed cellular elements change all the way through, fibrous tissue is the result of the pathological process, and you open into the tooth and find the tissue is dried up, is "mummified," and, too, without the use of any medicinal agents to bring about the condition. None of you, upon opening into the pulp-canal of a tooth under these circumstances, and finding the tissue thus mummified, the contents of the canal perfectly clean, no evidence of odor, no moisture, would think of leaving that tissue as a permanent root-canal filling. Is there any difference between this and the other condition? To my mind, not a bit.

In connection with this form of inflammation which works thus slowly in the pulp tissue, oftentimes before it has progressed sufficiently to involve the entire organ, there will be found to form hard deposits, seemingly calcific deposits, what we commonly refer to as *pulp nodules*. These nodules may be found, as to size, varying greatly, from the smallest up to large accumulations of this hard material. And as to number, they vary as much as they do in size. They may be found throughout the body of the root portion of the pulp, and when so found they are always small and of smooth outline. When found forming in the bulbous portion of the pulp they are more likely to develop to a larger size, so that not infrequently in opening into a pulp chamber, and of a molar tooth, too, you will find one of these calcific formations which very nearly fills the entire bulbous portion of the pulp-chamber. You will find them in other forms, where seemingly a large number of small ones which have been first formed have aggregated together and some element in the tissue has caused them to fuse, so to speak, so that their outline externally will be correspondingly irregular. Not infrequently you will find them very smooth all over their surface. Sometimes you will find them forming just at the entrance of the root portion of the canal, so that it is impossible for you to pass into the canal with your instrument. In such cases, especially where this has shaped itself so as to fill accurately the inaccuracies of the space in the pulp-chamber, it is likely to be mistaken for a secondary deposit of dentine, so-called, and the root-canal be obliterated. All these things, when thus discovered, should be examined thoroughly and carefully, because you may find that hardened substance loose, and when removed your canal remains open and free to be entered and treated.

As to the cause of the formation of these hard substances in the pulp chamber, the profession is not exactly clear. Experimentation and investigation along this line have not been prosecuted to a sufficient extent so that anyone is justified in stating positively just what the cause is. But these hard substances may be produced artificially, so that they resemble, in consistence, shape, etc., in appearance physically very closely those which are naturally formed in the pulp tissue. In the artificial formation there are three elements necessary; one is albumin in solution, another is salts of calcium and the other carbonic acid—carbon dioxide. If these three elements are confined in a tightly stoppered bottle, after a time the calcific formations will begin to accumulate at the bottom of the bottle, and, as I have stated, they seem to be just the same, so far as their physical appearance is concerned, as those formed in the pulp tissue. Hence the application of this theory to the pulp itself in relation to the cause of the formation of these calcific deposits. It would indicate that they only form in connection with inflamed pulps, or at least are more likely to form during the period that the pulp tissue is inflamed, when the circulation becomes stagnant, when there is an accumulation of carbonic acid gas in the blood, and the blood may also contain, and does contain, to a greater or less extent, the lime salts, and the albumin is had from the tissue itself. So that this theory of their formation seems a reasonable one.

NINETEENTH LECTURE.

Pathology of the Dental Pulp—Concluded.

In regard to the calcific deposits in the pulp, or the formation of hard substances in the pulp tissue, it had been my intention simply to touch briefly upon this phase of the pathology of the pulp, but in thinking the matter over I believe it will be well that we consider the various forms a little more fully than I had originally intended.

It is the generally accepted theory that these elements—albumin, carbonic acid gas and calcium salts—are necessary to the formation of these hard deposits in varicose veins, which are found to a very great extent with certain pathological conditions in the veins of any portion of the system, not being confined to the pulps of teeth. And it has been the teaching in the past, whenever these conditions bring about the deposit of these hard substances, that it is under the conditions referred to in the blood vessels of the pulp, and that these little hard substances will form thereby within the veins of the pulp tissue. But the results of recent investigations have failed to substantiate this theory positively in connection with the pulp. So that it is an open question whether these substances are thus formed within the veins of the pulp tissue or not. At any rate, when first formed from these conditions they are not very hard. They are found to be quite soft in most instances, so that in cutting sections of the pulp these substances are easily cut through with the knife of the microtome. In all probability, whatever be the manner of the formation of these hard substances at first, they form nuclei about which the lime salts afterward are deposited, and in this manner grow to become large, oftentimes occupying positions in the bulbous portion of the pulp-chamber to a great extent.

There are other classes of the formation of these hard substances, aside from these, which we will consider. And first of all, what are called *cylindrical calcifications*. And first, it may be well to consider this thought—that in the formation of this first growth of hard substances referred to, the nodular variety, it is not a calcification of the pulp tissue itself. The pulp tissue does not become hardened and is in no wise involved in the make-up of these nodules. They are rather accumulations or deposits of the salts of calcium chiefly within the tissue of the pulp, which make room for themselves in the organ by simply pushing the tissue of the pulp away. But in connection with the next class of calcific formation the tissue of the pulp itself is actually involved in the formation of the hard substances. The cylindrical calcifications occur, for the most part, in the root portions of the pulp, and they are observed first to be forming, the small, minute cylinder occupying a position lengthwise of the pulp of the root. At first they are very small; there may be but a few of them to begin with, but when first observed they may be numerous.

The pulp tissue, removed from a tooth in this condition and rubbed between the fingers, is observed to be of a gritty consistency, because of the presence of these little cylinders which have formed. After the process has progressed, and they become larger, possibly coalesce one with the other, and instead of there being very many of them they will have developed into a few, as regards number. They may continue until they occupy the entire root portion of the pulp of the root, but it is very seldom, even at this advanced stage of the progress of their formation, that you will observe them extending from the bulbous portion of the pulp to the apex of the root in an unbroken consistency; that is, one hard mass throughout the entire length of the root. But they will be more or less jointed, seemingly; the separate cylinders have formed and butted one against the other, and upon examination of the internal consistency of these formations it is found that the fibers of the pulp are actually involved in their formation, and that these separate cylinders which are thus held together are so held because the fibers of the pulp occupy a position inside of them and serve to hold them together. The tissue, when thus observed, is not very stiff and brittle, as would naturally be supposed, but is easily bent; more the nature of a small piece of lead; bent in a position it will occupy that position; or, if there is any crooked portion of the root of the tooth to which it has adapted itself it will assume that position upon being removed. This kind of formation in the pulp tissue is comparatively rare. You will seldom find the root portion of the pulp thus calcified throughout its entire length, but occasionally you will. And in this particular process of hardening of the pulp tissue the tissue is rarely ever attached to the inner walls of the pulp-canal, but is separate, and in the majority of instances can be easily removed.

It might be of some interest for me to relate one case which came under my treatment some three years ago; perhaps the most typical case of this kind that I have ever observed. It was in an upper right molar tooth of a gentleman living in Milwaukee, a brewer by occupation, and I have sometimes thought that this pathological condition was induced as a sort of retribution, because of the nefarious business in which he was engaged, but I do not make that statement as positive, because there might be another side to the question. At any rate, it was necessary to devitalize the pulp. Caries had extended so that the pulp tissue was exposed, and upon exploration with an instrument it was more or less sensitive; however, there was no hemorrhage. At any rate, I applied a small quantity of arsenic and at the end of two days the patient returned, and upon opening into the pulp-chamber I found the portion formerly occupying the bulbous part of the pulp-chamber more or less dried, contracted, and no sensation in it. I took hold of it with the points of the pliers and with little force the tissue from all three of the root-canals came away with it intact, and the tissue in each root-canal had thus hardened, calcified, lime salts had been deposited throughout its structure the entire length, so that the pulp from each root was just in the condition that I have previously described; was hard, yet not brittle; I could bend it considerably and it would not break, and the joints of the formation of the calcific cylinders could be observed one abutted against the other. Upon investigation the fibers of the pulp could be observed occupying positions throughout the internal parts of these cylinders, and this fibrous tissue served to hold them together, not permitting them to fall apart when thus disturbed.

Thus you will find this condition of things in all degrees, but you may practice a lifetime and not observe one such as I have just related.

As regards the calcification of the pulp tissue itself, I think we need not spend further time, but there are other conditions which occur within the pulp-chamber which it is well for you to understand, and the first I will term *Dentinal Tumors*, which develop within the bulbous portion of the pulp-chamber. These growths of secondary dentine frequently develop to such an extent that they very nearly fill the pulp-chamber itself. Decay sets in in the crown of the tooth at any portion and develops so that the dentinal tubules are irritated thereby, and at a portion somewhere near the inner wall of the dentine, where this irritation is thus transmitted through the tubules to the pulp tissue, a secondary growth of dentine is inaugurated. It will be attached to the inner wall of the pulp-chamber by a pedicle, so to speak, a small portion first growing out from the wall of the pulp-chamber, and the growth will continue until the tumor sometimes will occupy space represented by that drawing (indicating), and sometimes it will fill the bulbous portion of the pulp-chamber even more completely than is represented here. Sometimes you will observe these growths of very slight extent, and in all stages of development, from that which occupies a small bud on the side of the pulp-chamber to one which nearly fills the bulbous portion of the pulp-chamber. You will very frequently find these growths very nicely fitted into the entrance of the canal of the root portion, so upon opening into the canal, even though there is an opening along the side; for instance, a deposit has developed something like this (indicating), so that opening into the pulp-chamber in this position you enter this empty space, and yet the growth will have extended into the entrance of the root portion of the canal so that it is stopped, you cannot reach the root portion with your broach. And whenever it occupies a position like this you will almost invariably observe a secondary deposit having set in along the sides of the canal as represented thus (indicating), at the entrance of the canal, so that the canal at this point has been constricted, oftentimes being very difficult to pass the finest broach into that portion of the canal of the root. Whereas, immediately beyond that constricted portion it is open, free and of normal size.

This point is especially valuable to you when observed in connection with these pathological conditions because of this fact. Let me state just once more briefly so we will get this point clear. Whenever you find this tumor-like growth of dentine tissue within the pulp-chamber, and the entrance to the root portion of the canal is constricted, you are almost always sure that after you have succeeded in opening through that constricted portion of the canal, you will find an opening just beyond it throughout the remaining portion of the root. Whereas, when this canal at the entrance is constricted because of the calcification of the pulp tissue, as previously referred to, you will almost invariably find the constriction or the obliteration of the canal extending throughout the entire length of the root.

As to the consistency, both of these nodular formations and this growth of secondary dentine, it may be stated in a general way that they are composed, for the most part, of substances such as the dentine itself is composed of, although the individual form of these formations is unlike that of dentine. These depositions have not been carried on in the same regular systematic way that the development of the dentine tissue has, so that in structural form they vary very considerably; yet they contain virtually the same kind of elements that the dentine tissue contains. In these growths of secondary dentine, often in sections which have been cut and examined the formation has been very much like that of regularly formed dentine; yet it is almost invariably more or less different in this particular.

Another form of the development of secondary dentine, within the pulp-chamber, is this. The lime salts, instead of beginning to be deposited along the inner wall of the pulp-chamber at some particular point, and thus growing from that, retaining the pedicular-like attachment to the wall of the pulp-chamber, begins to be deposited all over the walls of the pulp-chamber in some instances, so that a thin layer is developed all over the roof, so to speak, of the pulp-chamber, as represented here (indicating). It may also be developed along the side of the pulp-chamber and it may be developed along the floor of the pulp-chamber, layer by layer, until the pulp-chamber is very largely obliterated because of the deposit of these salts of calcium in an even layer all over the inner walls. But in most instances you will find the deposition of these substances along the roof of the pulp-chamber and the floor of the pulp-chamber to a greater extent than along its lateral walls. This condition of things may also be observed at any degree of development, from very slight until the pulp-chamber itself is almost, if not quite, obliterated.

What is the cause of the formation of these secondary growths of dentine within the pulp-chambers of teeth? It has been observed and is the teaching of most pathologists on this subject, that by far the greater number of cases in which these nodular formations occur, in which these various forms of secondary dentine occur, are in teeth which have greatly suffered from caries, or from abrasion or erosion, so that the crowns of teeth have been considerably wasted by these pathological processes. And especially in cases of mechanical abrasion where the crowns of the teeth are worn away evenly throughout the entire extent toward the gum line, you will observe in most instances the formation of this secondary dentine, as represented in this last illustration, occupying a thin layer all over the roof of the pulp-chamber. In cases which have suffered from caries, especially in which the cavity has developed upon the side of the crown of the tooth, so that a small number, comparatively, of dentinal tubules have thus been irritated, and which irritation is thus transmitted to a small portion of the bulbous portion of the pulp, you are more liable to find the tumor-like growths of secondary dentine, as represented first, and also in these latter cases you are more likely to find the formation of pulp nodules. Undoubtedly many of you have observed, and especially in an incisor tooth, where the crown of the tooth has been worn away by mechanical abrasion—worn down half or two-thirds of the way to the gum line. As the wearing process has progressed the pulp has receded, as we refer to it. This secondary deposit of dentine has been induced over the roof of the pulp-chamber so as to protect the living tissue from the encroachment of the wasting process of the crown of the tooth. And in teeth which are sufficiently worn you will be able to observe on the exposed surface of the dentine the former outline of the pulp-chamber, and the secondary deposit being thus built in. And not infrequently you will see in this condition of things the entire bulbous portion of the pulp-chamber filled up with this secondary deposit, and the pulp having thus receded so that it is not found until you actually enter the root portion of the canal. You will observe this also in molar teeth when sufficiently worn.

In color these secondary deposits are almost invariably different from that of natural tooth structure so that their outline is easily observed. So that we may say, in short, that these formations are induced through some form of irritation to the fibrils of Tomes, and that these deposits—in consequence of the irritated condition of the pulp, and other abnormal conditions which possibly are not clear to the dental profession—the hard formations are thus brought about.

As to *symptoms* in connection with these various pathological conditions, there is very little that can be said, because it is true that you will find cases in which these nodular deposits have been formed throughout the bulbous part and throughout the root part of the pulp of the tooth in large numbers where the patient will give no history whatever of pain or manifestation of irritation or any disagreeable manifestations whatever. I say you will sometimes find just such cases, but as a general thing there is more or less disturbance caused by the formation of these elements. There is more or less irritation manifested, and while the pain is in no wise severe, there will, in the majority of cases, perhaps, be more or less pain manifested. The pain, whenever thus manifested, will almost invariably be that of the irritated condition of the pulp; rarely ever will you find it severe, paroxysmal as is the case of pain from hyperemic conditions of the pulp. But I have seen cases where the pain was thus severe, and you never know, from either subjective or objective symptoms in connection with these cases, whether this condition is in the pulp or not until you have opened in and discovered it. The thought is this—that there are no symptoms manifested that we can observe; there are no subjective symptoms, or those which the patient is observing and which we cannot see, such as pain, that constitute accurate diagnosis of these pathological conditions. Occurring, as they do, in connection with caries frequently, or in other wasting processes that make it necessary to devitalize the pulp, after opening into the pulp-canal and finding this condition of things, then your diagnosis is complete, and not until then. It was the teaching of some a few years ago; I remember distinctly when I first took up the study of dentistry that one positive evidence, according to the teaching, of the presence of calcific deposits within the pulp tissue of teeth was the appearance of yellowish spots on the enamel throughout the crown of the tooth, and this was advocated, and I remember distinctly many papers were written and published in the journals to this effect, that whenever these nodular deposits were formed in the pulp tissue there would always be the appearance of these yellowish spots in the enamel. But, in my judgment, and the judgment of others, there is absolutely nothing to this theory. I know of many teeth that have been opened into in which these characteristic yellowish spots appeared at all positions in the enamel, in which there were no calcific deposits whatever.

As regards the treatment of these conditions. We never know what the condition is, as I have stated, until from some cause it becomes necessary to devitalize the pulp. So that this condition may run along for almost any length of time without the manifestation of any trouble. The patient in no wise suffers pain from the presence of these deposits until they become so extensive, so numerous as to cause irritation to the remaining portion of the pulp and thus cause pain and thus make it necessary to devitalize. Until this condition of things is brought about there is no treatment indicated, and whenever this condition is brought about there is only one form of treatment, and that is devitalization.

You will sometimes observe teeth in which these hard formations have continued until the entire root portion of the pulp-canal is obliterated and the tissue, seemingly, is fastened, so to speak, to the dentine itself, so that it presents, when opened into, a perfectly hard, resistant structure throughout the entire length of the root-canal. It is impossible to find any opening at all and there is none of this hardened mass in the root-canal that is loose so that you can remove it or disturb it in any wise, and in consistency it is as hard as the dentine tissue itself.

What shall we do with such cases as these? And, by the way, within the last week or two we have had three just such cases in the infirmary. The only thing to do is to let them alone; fill the cavity and leave the case to itself.

In connection with these cases the hard tissue thus occupying the root-canal, as I stated a while ago, will be in color different from that of dentine so that its outline can be distinctly observed. But I want to tell you about one case which came under my observation two or three years ago in which this difference in color was not to be observed. It was an upper lateral incisor tooth. The entire bulbous portion of the canal and the root portion had been obliterated, either from the deposit of secondary dentine or the calcification of the pulp tissue, and so far as any physical appearance was concerned there was no difference between that and the dentine itself. That tooth was drilled into carefully two-thirds the length of the root, and all the way the tissue was as hard and dense and firm and natural in appearance as any part of the dentine tissue. Such cases as these you will very seldom see.

There is another element connected with these pathological conditions which is of importance, and that is the condition of the odontoblastic layer of cells. What is the condition of the odontoblasts while these formations are being carried on? And it may be said in a general way that in connection with the formation of pulp nodules proper, the calcific formations which occupy a position within the pulp tissue, the odontoblastic cells in no wise change. They remain in a normal condition so long as the pulp remains alive. But a very different condition develops in them in connection with the formation of secondary deposits of dentine. In connection with the growth and formation of the tumor-like dental growths, as referred to, the odontoblasts immediately at the exposure, and for some little distance each side of the exposure, whose fibrils have become involved in the irritating process, will lose their power to transmit sensation to the pulp; their functions are done away with, so to speak, so that a portion of the dentine tissue which formerly was supplied with these fibrils has lost its sensation; you can cut into that tissue to any extent, and there is no pain occasioned thereby. In connection with the growth or development of secondary dentine to the extent represented by this picture (indicating), after the crown of the tooth has been worn away by mechanical abrasion, the fibrils of Tomes which formerly supplied these dental tubules, extending out to the occlusal surface, have also been robbed of their power to transmit irritation, because this dentine has been deposited immediately over them and they have been thus obliterated. And so you will be able to cut into the dentine of teeth in this condition without causing pain, simply because the odontoblastic layer of cells have been obliterated through the medium of the deposition of secondary dentine.

This will finish the consideration of the pathology and therapeutics of the pulp.

Do not form the idea from this that secondary dentine always forms in the pulp-chambers of teeth thus wasted by abrasion. Ofttimes the dentine of these teeth is exceedingly sensitive, and when it is, there is no deposit of secondary dentine, and consequently no destruction or obliteration of the odontoblasts.

TWENTIETH LECTURE.

"Pyorrhea Alveolaris."

What is "pyorrhea alveolaris?" I wish I could tell you. If I were able to make a statement on this phase of the question that would leave no opportunity for future doubt in your minds, I would be doing more, in my judgment, than anyone has done up to the present time.

However, there are men in our profession who would have us think that there is no longer room or necessity for doubt either as to the etiology, the prognosis or the treatment of the diseased condition under present consideration. They are very firm in their convictions, positive in their statements, and above all things else, irrevocably unwilling to admit that there is any possibility that they are in any wise mistaken in their conclusions. And the remarkable feature in connection with all this is that their individual teachings are so widely at variance.

We find one class satisfied to consider as purely local conditions all the pathological changes occurring in the parts and accompanying a deposition on the surfaces of the teeth of either salivary or serumal calculus—differentiating between the two by the use of the expressions "ptyalogenic calcic pericementitis" and "hematogenic calcic pericementitis" respectively; while the cause of "true pyorrhea," as they term it, the symptoms of which are so different, and the cases of which do not yield to the usual methods of local treatment, is ascribed to the accumulation of uric acid salts upon the apices of the roots of teeth.

In support of this theory the author presents the results of analysis of deposits found upon the ends of roots of teeth. Because uric acid was found in the majority of the analyses made, the, to me, illogical conclusion was formed that uric acid in the system is the cause of "true pyorrhea alveolaris," and that the main energy in the treatment must be by way of eliminating from the system this accumulated monster—uric acid. Is it unreasonable to suppose that had these deposits, taken from the roots of teeth, been subjected to proper tests for the purpose of discovering the presence of other substances, that the investigator would have been rewarded with success? Such tests have been made, and such substances as iron, lead, mercury, sulphur and manganese have been found in varying quantities.

Would not the logic of the one who would ascribe "pyorrhea alveolaris" to the presence of any one of these substances be just as sound as that of the other who has ascribed it to another substance?

Another writer, almost in his opening sentences, stated "the exciting cause of pyorrhea alveolaris," which latter he describes as "purulent discharge from the alveolar region," "is invariably some *local* irritation which, not being removed, sets up a condition of inflammation which prevents nutritive repair of the diseased pericemental tissue." Then he divides the "disease," as he calls it, into "two general classes;" "one where the *exciting* cause is practically the only cause of the disease, and which makes the"—now he says—"condition," instead of using the word "disease," "purely a local trouble." And adds, "this form may be called *pyorrhea simplex*, in contradistinction to the other class, *pyorrhea complex*, where there is a predisposing cause back of the local irritant." A little farther on in his article he says, under the head of *pyorrhea complex*: "Although in all forms of this disease our chief duty is to keep the mouths of our patients free from any exciting causes and to reduce all conditions of inflammation, still, where there is a predisposing cause which in itself is productive of the local inflammation and the irritation against which we are contending, this predisposing cause in such cases becomes *the* cause." This is a direct contradiction of his first statement, as his language is worded. What does this mean? Simply that he has formulated a theory which no doubt to him seems to be a plausible one, and as we shall presently see is in a way a most remarkable one. Having formulated the theory he makes a bid for its acceptance by placing it before us in language that is necessarily contradictory because of the remarkable character of his doctrine. In answer to my query, "What does this mean?" remember my opening statement, that I am dealing with a subject about many phases of which I know nothing, and with no disrespect to anyone, I believe there are many others who know just as little about these things as I do. When one knows his subject, when he is certain that his theories are correct, it is never necessary that contradictory language be used in presenting them.

Farther on in the articles above referred to the writer states in effect that an individual suffers with a distinct form of pyorrhea alveolaris, accompanied with its own individual set of symptoms, to correspond with the systemic disease with which he may be afflicted, as "gouty pyorrhea," "diabetic pyorrhea," "tubercular pyorrhea," "anemic pyorrhea," "pregnancy pyorrhea." And to make a very long story short, toward the latter part of the article he makes the following remarkable and sweeping statement: 'It has been my aim to call your attention to the fact that, leaving pyorrhea *simplex* aside, the forms of pyorrhea *complex* that we may meet are limited only by the number of ills that humanity is heir to;" and adds that, "Attention is invited to the fact that each form of pyorrhea complex presents clinical symptoms so separate and distinct that they can easily be recognized by the observant dentist."

According to this, if a person be afflicted with softening of the brain he would necessarily suffer with a form of pyorrhea, the manifestations of which would correspond with the systemic affliction. If a person be afflicted with fatty degeneration of the heart he would necessarily suffer with a form of pyorrhea, the manifestations of which would correspond with the systemic affliction—who can imagine what kind of manifestations these would be? Again, if a person be afflicted with chronic diarrhea he would necessarily suffer with a form of pyorrhea, the manifestations of which would correspond with the systemic affliction—and what awful manifestations these would be.

I do not thus refer to these phases of the article for purposes of ridicule, but to show the fallacies one indulges in when he presents such theories and makes such statements as the only reliable ones in connection with a subject of this character.

Another prominent writer, who calls this affliction "interstitial gingivitis," regards the causes as almost entirely local in character, and agrees that various systemic disorders serve to aggravate the local pathological manifestations.

Another up-to-date writer regards pyorrhea as purely bacteriological in origin, and claims jointly to have discovered the bacilli of pyorrhea alveolaris. At the same time he has always claimed to effect marvelous cures by purely mechanical means.

It may not prove uninteresting to refer briefly to the ideas of prominent men from the early times as to the cause of pyorrhea alveolaris.

In 1740 H. A. Fauchard recognized this affliction and described its essential features, but offered nothing as to its cause. In some of the medical dictionaries you will find

In 1778 M. Jourdain regarded this affliction as of scorbutic origin.

L. Koecker in 1821 discussed the disorder in a general way as the devastations of the gums and alveolar processes, but advanced no specific theory as to its cause.

In 1860 Marshal de Calve considered the disorder as hereditary.

Magitot in 1867 considered systemic disorders, such as gout, rheumatism, albuminuria, diabetes and anemia as having an indirect influence in the production of the disorder.

In 1870 serumal calculus was mentioned in this connection by a Mr. Brown.

In 1875 John M. Riggs described the malady as a suppurative inflammation of the gums and alveolar process. Not infrequently do we hear this trouble spoken of as Riggs' disease.

It is my belief that in all instances where the pathological conditions obtain, commonly referred to as pyorrhea alveolaris, that the presence of pus is nothing more nor less than a condition superinduced by the various pathological conditions that always precede pus formation in any portion of the system. Inflammation of the soft tissues about the roots of teeth is a condition of this pathologic state, as is swelling of the soft parts; recession of the soft tissues; looseness of the teeth; the presence of calcarious deposits; the presence of pus; and the pus present is there as a result (to take the processes in their order) of the disturbance of the local parts by the irritant, whatever it may be, the inflammatory process following being accompanied by the infiltration of the surrounding parts with the characteristic inflammatory exudates, this in turn becoming infected with pus-forming micro-organisms, thus inaugurating the process of fermentation, which results in liquefaction of these various elements involved, this liquid constituting pus. Thus you see the pus is present only as a natural result of the pathological conditions through which the parts have passed. When we remember that *pyo* is of Greek origin, signifying pus, and that alveolaris is of Latin origin, referring to alveoli, or the sockets of the teeth, what right have we to use the expression, "pyorrhea alveolaris," to give name to a specific disease? My answer is none save custom, and remember that custom is not always a safe guide to follow.

What, then, shall we call this condition, or disease, or whatever it is? Some years ago Dr. Black classified the diseases of these parts, having their origin at the gingival margin, as *gingivitis*, *calcic inflammation* and *phagedenic pericementitis*. Up to the present time no one, to my mind, has suggested a better classification. Gingivitis, or inflammation of the soft parts immediately about the necks of teeth, results from many different causes. These causes may be local or of systemic origin. Most frequently they are of a local character. The accumulation of calculus, either salivary or serumal, is a very frequent cause. The accumulation and retention of micro-organisms and particles of food and other foreign material, which should not be permitted to remain about these parts, constitutes a frequent cause of gingivitis. An acid condition of the mucus which is exuded from the free margin of the gums is a not infrequent cause. Injury to the free margin of the gums not infrequently induces severe inflammation. I might occupy much time in enumerating local causes of this pathological state, but it is unnecessary. Among the causes which may be said to be of systemic origin is the presence about the necks of teeth of irritating drugs, which have been taken internally, carried to different parts of the system by the circulation, and portions are eliminated through or by the peridental membrane. Drugs or materials which perhaps most frequently disturb these local parts in this way are mercury, lead and phosphorus. When an individual is suffering from systemic mercurialism, or plumbism, or phosphorism, and the local parts in question become diseased in the manner as outlined above, and pus forms—which latter element is necessary before we have any right to refer to the diseased condition as "pyorrhea alveolaris"—I contend that the presence of these various poisonous drugs or elements in the system cannot properly be referred to as the direct cause of that individual being tormented with pyorrhea, as we call it—an indirect cause, certainly. The local parts being irritated by these poisons, the irritation long continued, inflammation and infiltration follow, infection, fermentation and liquefaction occur in their natural order. If these poisons in the system were the direct cause of pyorrhea, is not the statement a logical one that individuals who are thereby afflicted would suffer a spontaneous breaking-out, so to speak, of pyorrhea in the mouth? That they do not in many, many cases cannot be disputed; and, on the other hand, many who have never been afflicted with these constitutional ailments have suffered with "pyorrhea" in its most virulent form. This statement is such a patent fact that I need take no time to relate statistics or to cite cases in its further support. Hence *gingivitis* (inflammation of the gingivæ, induced by these irritating substances, whether of local or of systemic production) is the name of the disease. The presence of pus is only a condition and does not give name to a specific disease.

Calcic Inflammation: A pathological condition of the parts about the teeth with which you are all familiar—a diseased condition induced by the presence of calculus, whether of serumal or of salivary variety. These deposits, especially the salivary, possess peculiar properties that are invariably destructive to soft tissue. It is an axiom, or should be, for clinical experience and observation make it such, that the soft parts about the teeth cannot remain healthy and retain their structural form when in contact with salivary calculus. Thus let the breaking down of these tissues under these circumstances, the presence and the spread of inflammation, the looseness of the teeth, and the presence of pus, etc., be spoken of as conditions naturally brought about by the workings of the disease—calcic inflammation.

Phagedenic Pericementitis: A disease of the parts about the teeth, especially the peridental membrane, that is peculiarly characterized by the formation of narrow pockets along the sides of the roots. The etiology of this disease is not definitely settled. As we have been told by Dr. Black, it is very likely the result of the action of a specific form of micro-organism. This theory certainly seems a plausible one, when you understand the somewhat remarkable characteristics of the disease. Pockets may be formed to a great extent without the show of any inflammation, or any appreciable looseness of the tooth, or any recession of the gums, or any accumulation of serumal calculus, and without the formation of any pus; while perhaps in the majority of cases the reverse of these conditions obtains. In these facts we find a strong argument in favor of not calling the disease *pyorrhea*, for when pus is not formed the disease —*phagedenic*—is present just the same, and when pus is formed it is present as a natural result of the workings of the disease, together with its complications—only a condition.

True, there are cases of "pyorrhea" that are obstinate and persistent. In spite of all that can be done by way of treatment in a local way pus continues to flow; not infrequently the pockets about the teeth have developed to a considerable extent; there are apparently no accumulations of serumal calculus on the surface of the cementum; in fact, nothing is apparent of a local nature in this connection to which might be ascribed the responsibilty of a continuance of the destructive process and of pus formation, yet there is present every local indication of severe irritation—the gums are inflamed, probably swollen, the margins everted and more or less denuded of their epithelium, and they bleed on the slightest provocation. It would seem that those who advocate a primary systemic cause for "pyorrhea" have a just foundation for their doctrine in connection with such cases as cited above. Whether they are right or wrong I shall not presume to say, and no man is justified in making a positive statement in this connection one way or the other. Sufficient proof of a positive nature has not been adduced from the experimental work, and from the investigations that have thus far been prosecuted, to warrant an inflexible stand being taken on one side or the other. When you reflect that such cases as here last described are found in the mouths of individuals who, because of inborn idiosyncrasy are especially susceptible to the irritating effects of such poisonous drugs and elements as above referred to, and until something of a positive nature in this connection is produced, is not the following worthy of some consideration, namely, that there is in the system of that individual some of the poisons referred to that are being carried about in the circulation, and are being partially eliminated by the peridental membrane? The gums at their margins being thus irritated and inflamed, infection naturally occurs and pus forms. This seems to me a much more plausible theory than that all the local conditions spring up of a spontaneity and inevitably because the general system contains poisonous elements.

Of the diagnosis of the various local diseases attended with a flow of pus I need say nothing. This constitutes one realm of pathology with which the dentist has to deal that of diagnosis itself. Of the prognosis we are by far less certain. The probability or improbability of recovery depends upon many conditions. The extent of the destruction of the tissues involved; the ability of the operator to diagnose and successfully remove the local causes of irritation, and his aptness to recognize the presence of any systemic elements that may be producing local irritation; also his ability to recognize the various lines of therapeutic action called for by the various pathological conditions of the parts, together with his ability to select for use the proper medicinal agents to supply these needs; also the age and physical condition of the patient, and his or her diligence in properly caring for the parts after treatment is administered.

Treatment of these affections depends entirely upon the nature of the cause or causes that serve to continue them, and upon the various conditions, both local and systemic, that present in each individual case. In dealing with this phase of the question I deem it unnecessary to indulge in a detailed account of methods of procedure or of medicinal agents as means to be applied, but rather will consider the principles involved in this connection. If calculus is the exciting cause of the disease, and there is no considerable destruction of tissue and no systemic complications, a thorough removal of the deposits is usually all that is necessary to effect a cure. If the patient be advanced in years and physically feeble, the local use of stimulating antiseptics will assist materially. If the exciting cause be an acid mucus, or an abnormal condition of the saliva, or an accumulation and retention of micro-organisms and other foul matter, the cause must be corrected—must be removed. In the first instance alkaline solutions must be used in a local way. If the destruction of tissue is considerable and deep pockets have developed, pus is flowing freely, the gums are inflamed and engorged with blood, but no systemic complications, the treatment indicated is as follows: First, a thorough removal of the local exciting cause, whatever it may be. Appropriate germicides must be used freely in the pockets, and when I say freely I mean diligently as well. A side thought in this connection which may be of interest: After having thoroughly removed the deposits and cleansed the pockets with germicides, completely washing the pus away, and perhaps repeating these same operations two or three times, the patient returns, and there is no more tartar present, but pus continues, some are puzzled to know why this is so. Let me refer to a beautiful little illustration in this connection used by Dr. Black in his writings. When you were boys and used to hoe the corn and the potato patch, and weed the onion bed, you effected the destruction of all weeds in sight at the time, but in a few days you would be somewhat surprised to see as many more weeds growing in those patches, and in your childlike simplicity would wonder where they came from. With your hoeing you destroyed the weeds in sight, but you could not destroy the seeds that were lying dormant within the soil, only awaiting a favorable opportunity to spring forth and produce another crop of weeds.

When you thoroughly cleanse the pus pockets with germicides you do away with the pus and you destroy the germs that are visible, so to speak, but you do not effect the destruction of the spores that have insinuated themselves into the surrounding tissues, the latter frequently being completely studded with them, and which continue to come forth and cause pus formation. Hence the necessity of continued use of germicides in these cases.

The use of antiphlogistics to control the inflammation is essential. This form of treatment will mainly be local. However, not infrequently systemic agents in this connection assist materially. Agents administered internally that assist in slowing the blood current, thus preventing to a degree an undue quantity of blood flowing to and through the affected parts, are of material assistance in this connection.

Astringents are also indicated in the treatment of these cases. Agents that cause contraction and condensation of the tissues and also assist in lessening the secretions. These are to be used locally. I believe no special advantage will be had from the use of remote astringents, or those to be taken internally and which act upon different parts through the medium of the circulation of the blood.

When this disease so termed is aggravated or indirectly excited by systemic disorders, one cannot hope for best results, or even satisfactory results, unless these disorders are recognized and are properly treated.

Whenever the teeth are much loosened it is necessary that some form of mechanical appliance be adjusted. The teeth should be held firmly in their sockets to prevent irritation of the soft tissues which otherwise would result.

One's habits and diet are especially important factors in connection with the successful treatment of these disorders. An individual of sedentary habits—much indoors, little exercise, and an indulger in wine, tobacco and a meat diet, is not a favorable subject for successful treatment. His habits should be exactly the opposite. Plenty of exercise in the fresh air is necessary; the diet should be simple but nourishing; liquor and tobacco should be indulged in sparingly, and the process of elimination in all its phases should receive proper attention. Saline cathartics and thorough flushing of the system with water are essential.

Last, but by no means least, the teeth should be thoroughly and persistently exercised. I believe vigorous exercise of the teeth and the surrounding parts by chewing hard food is of much more value by way of stimulating and strengthening and hardening the soft tissues involved than has been ascribed to it in the past.

TWENTY-FIRST LECTURE.

Pathology and Therapeutics of the Peridental Membrane

I believe I announced that next we would take up the consideration of the pathology and therapeutics of the peridental membrane. I have no doubt that you have all been thoroughly drilled on the peridental membrane, its histology, its anatomy, its various divisions, cellular make-up, etc., but with this tissue, as with others we have considered, I want briefly to touch upon these points in order that the essential elements in the make-up of this organ may be fresh in your minds, as we shall proceed at once to consider its diseases and their treatment.

You well know that the peridental membrane is that soft tissue which occupies the space between the cementum covering the root of the tooth and the inner plates of the alveolar bone, extending as far as the rim of the alveolar plate and a little farther. Remember that point, that the peridental membrane not only occupies the space between the cementum and the alveolar plate of bone, but the membrane proper extends a little nearer the gingiva, or the neck of the tooth, as commonly referred to, than does the rim of the alveolus. This membrane varies much in thickness in different individuals. It is in the main thicker in young people than in old. Naturally the membrane becomes thinner, the space between the cementum and the alveolar wall becomes less as the patient grows older.

Various names have been ascribed to this membrane by various writers from the early ages down, and in the earlier literature on this subject you will find these expressions: *alveolar dental membrane, dental periosteum, alveolar dental periosteum,* and a number of others. . There are two expressions used at the present time in referring to this membrane, which are, in fact, in the literature of the present day, almost exclusively used; one the *peridental membrane,* which is, perhaps, used more frequently than the other, which is *pericementum.* The former expressions I would not advise you to adopt now, but either of the latter two, preferably *peridental membrane.* If you were to use the other, *pericementum,* certainly you could not be censured for it.

The offices of this membrane may be said to be three-fold, *functional*, *physical* and *sensory*. *Functional* because it is the seat of the development of certain cells, whose business it is to build certain tissues. It is the seat of the development of the *osteoblasts*, which build portions of the alveolar wall on the one side. It is the seat of the development of the *cementoblasts*, which build the cementum on the other side. These cells seem to come into the meshes of this membrane from the blood current, first in the form of leucocytes, which, after passing into the tissue, at the proper time develop or undergo those changes which are necessary to bring about from them the formation of *osteoblasts* and *cementoblasts*, and during the process of development or change which is necessary they seem to take up and do take up their respective positions, the osteoblasts on the one side, where the alveolar plate is to be developed, and the cementoblasts on the other side, next to the root of the tooth, where the cementum is to be developed.

Physical, because it serves to hold the tooth in the socket. This is a passive function, and, as we shall see, is performed by the membrane as a natural result of its structure, of its form of development, of the manner of the attachment of its fibers to the hard tissues on either side.

Sensory, because, as we have stated several times in the past, it is the organ of the sense of touch of the tooth. The nerves and blood vessels are supplied to the membrane in the main as they are to the pulp of the tooth. Blood vessels and nerves pass into the apical space through the bone, and certain portions of them pass through the foramen to supply the pulp, and other portions of them pass down the sides from the apical space into the tissue of the peridental membrane, and thus passing along through the tissue they divide and subdivide so that the peridental membrane is very rich, both in vascular supply and nerve supply. This, however, is by no means the only source through which blood vessels and nerves are supplied to this membrane, because we have learned—if not, remember it from now on—that the alveolar plates of bone on each side of the root, in fact, entirely surrounding the root, are themselves very richly supplied with blood vessels and also nerve filaments or fibers, which traverse mainly the same channels as do the blood vessels themselves. This bone tissue is filled with Haversian canals, through which these vessels pass, and through which they pass from the bone into the peridental membrane, as you see represented by these openings (referring to picture), ramifying throughout the plate of bone and passing into the tissue of the peridental membrane. So that the blood and nerve supply is received from these two sources, the alveolar plates of bone and from the apical space.

I made the statement a moment ago that this membrane is the organ of the sense of touch of the tooth. We had more or less to say on that particular point when considering the pathology and therapeutics of the pulp, but just a few words more in regard to this point. It can be definitely and easily illustrated that this tissue is the organ of the sense of touch of the tooth. In times past, writers, some of them—some of them of international repute—brought forth the claim that the enamel tissue was mainly the organ of the sense of touch of the tooth. But not so. You press with the finger or with an instrument upon any portion of the enamel of a tooth and you can locate exactly which tooth is thus being pressed. If we should stop right there it might reasonably be argued that the enamel has as much to do with locating pressure as the peridental membrane. But press in one direction upon the tooth quite firmly, and at the same time press upon the other side of the crown of the tooth on the enamel, and the latter touch is not noticed; you are not conscious of it unless the pressure from the latter source is sufficient to overcome the other pressure which is being exerted upon the opposite side; if so, then you are conscious of the tooth being pressed upon the other side; if not, you are only conscious of the first pressure upon the tooth. If the seat of the sense of touch were located in the enamel tissue you would be conscious of its being touched, no matter in what position, no matter what sort of pressure might be exerted on it from a different direction. The statement once more, by way of emphasis, that this is the only organ of the sense of touch of the tooth.

While we are considering this line of thought we may as well refer to the consequences, if any, providing a portion of the membrane is destroyed. For instance, an abscess develops in connection with the tooth, and a large area of tissue in the apical space is thus destroyed; the pus burrows laterally along the side of the root so that much of the membrane tissue is destroyed. The blood and nerve supply is cut off entirely from the opening of the bone, directly into the apical space, because of the development of this abscess, but the remaining portions of the membrane are left intact, are healthy. Will that destruction of the portion of a membrane in any wise affect the ability of the tooth to locate the sensation of pressure? It will not. Neither does it in any wise affect the nourishment of the remaining portions of the membrane, or the nerve supply, because, as stated, the membrane is sufficiently supplied from the alveolar plates. And the same with destruction of portions of the membrane along the side of the root, as we shall see when we consider phagedenic pericementitis, especially. The entire membrane over one surface of the root may be destroyed to the apex and the remaining portions of the membrane remain healthy and intact. And yet, the ability of that tooth to locate pressure, or its locating sense, is not materially interfered with.

In regard to the position of the fibers of this membrane, it is of the utmost importance that you understand, or that your minds be freshened as to the relative position of the fibers of this membrane. And remember, if any of you have forgotten it for the time being, that the fibers of this membrane do not extend lengthwise of the membrane itself, or parallel with the long axis of the root of the tooth. It is almost invariably the case that in soft tissues throughout the body the fibers making up those tissues extend in the direction in which the tissue is the longest. Not so in connection with the peridental membrane; exactly the opposite. These fibers, which serve to attach the tooth in the socket, which themselves, as we shall see, penetrate into the substance of the cementum on the one side and into the substance of the bone on the other, are of the white, inelastic, fibrous variety; these we refer to as the *principal* fibers of the peridental membrane, because they are the ones that serve to hold the tooth in the socket. We shall see a little farther on that there are other elements and other tissue in the peridental membrane aside from these. But get the thought firmly fixed in your minds that these which hold the teeth in the socket are termed the *principal* fibers of this tissue.

At the gingival portion, or at the neck of the tooth, these fibers extend from the cementum in bundles and pass out over the rim of the alveolar bone into the gum tissue, a small portion of them. A little farther up they pass directly from the cementum into the bone tissue, and possibly in the lower third or lower fourth of the extent of the peridental membrane it may be said that these fibers pass directly across, or nearly at right angles from the surface of the cementum to the inner surface of the bone. As we approach the end of the root they become deflected more or less from that direct course, and you will find them occupying a position represented in the direction of these lines (indicating), passing from the cementum toward the gingiva, so to speak, and become fastened in the bone in that position. Thus, to the end of the root, until you reach the apical portion of the membrane, when they spread out in all directions in a fan-like shape. What is the reason of these fibers being deflected from a course at right angles with the surface of the cementum in the portions of the membrane as you approach the end of the root? Why has nature thus placed them in these portions of the membrane? So they will be more effective in resisting the force of mastication. You can readily understand that if they pass at right angles the entire length of the root, force upon the incisal edge or occlusal surface would press the tooth into the socket more readily than when they occupy a position as I have described, because the force extended upon the tooth is along the long axis, or more nearly so, of the fibers themselves; thus they receive and resist the force of mastication to a great deal better advantage than if otherwise placed. These fibers that pass near the gingival portion from the surface of the cementum, over the rim of the alveolar plate, and into the tissue, who can tell me what special name or expression is used in referring to these little bundles of fibers in this position? A.—The dentinal ligaments. Whenever you hear or read the expression, dentinal ligaments, it simply means those bundles or *principal* fibers of the peridental membrane at that position, which serve in a large measure to prevent lateral movement of the tooth. Thus you see that this distribution of these *principal* fibers of the membrane is in the best possible manner to serve the purposes for which they are intended. Can anyone tell me how it happens that these fibers of this membrane are actually imbedded into the surface of the cementum on the one side and the substance of the bone on the other? The membrane is developed and in position before the bone tissue is developed, and these fibers of the membrane are extending across this space as they are to remain after the hard tissues are developed, and as the lime salts of the hard tissue on either side are deposited under the direction of their respective cells they are deposited and hardened about the ends of these fibers. Hence, we find them actually imbedded into the substance of the hard tissue after the tissue is perfectly formed.

There is a system of cells, or lymphatics, more properly called, in this membrane, and it is very necessary that you understand and remember that they are there when we come to consider the therapeutics of some forms of disease of this tissue. It has been denied persistently by early investigators, and by investigators of more or less repute almost down to the present time, that the tissue of the peridental membrane possesses lymphatic vessels. Prof. Black, however, has claimed for a long time, and has prepared sections of the membrane which show this system of lymphatic vessels; has had them for years; yet, in face of this, quite a number are persistent in denying their existence.

This fact cannot be denied, that certain drugs taken into the system become exuded, or their active principles become exuded about the necks of the teeth, or from the free margins of the gums. The active principles of these drugs are taken up by the circulation in the various portions of the system and are thus carried to this membrane; if there were not some system of cells or lymphatics in this tissue through which they could pass, and thus be thrown off as foreign material, this result could not be brought about. These lymphatic vessels, we may say, without any doubt, do have a place in this membrane; there can be no doubt as to that, and they occupy a position along the entire root of the tooth close to the cementum. Sometimes we will find little bundles or little accumulations of glands nearer the alveolar bone, and sometimes occupying a position throughout the central portion, but in the main they occupy a position along nearly parallel, and very close to the cementum. And it is because of the presence of this system of lymphatic vessels that the peridental membrane yields so readily and so nicely to treatment.

You have all had experience enough by this time to know that in the severest forms of inflammation of this membrane, after the irritating cause or the exciting cause has been removed, the membrane will recover, the inflammation will subside with almost no other treatment. Oftentimes in the severest cases local treatment, sometimes systemic treatment, hastens recovery, but in the vast majority of cases if the exciting cause be removed and the tissue left to itself, it will recover without delay. And this readiness to recovery from disease is due very largely to the fact that this system of lymphatics is present, which serves to carry away these poisonous products, which continue the inflammatory movement. I think I stated that the pulp tissue contains no such system of lymphatics, and because it does not contain this system of lymphatics, no doubt, is very largely the reason why so many pulps die instead of recovering from the inflammatory movement; or when a small portion of the pulp suppurates, it does not possess the power or the ability or that element necessary to carry off these poisonous products that accumulate, remain and thus cause strangulation and death of the tissue. Whereas, if they possessed such a system there is no question but that a great many pulps that otherwise die would recover. This distinction between these two tissues is a necessary one to be remembered.

This tissue also possesses, aside from these three forms of cells or vessels referred to, *epithelial* cells, which serve to augment or to repair the tissue when a portion of it is destroyed, because this tissue may be, and often is, reproduced to a very great extent after having been destroyed by calcarious deposits or other forms of disease.. It also possesses large numbers of undeveloped cells—cells which are not perfectly organized—which seem to have no special purpose except to occupy space.

This membrane is divided anatomically for convenience of study and reference into three divisions: *Gingival*, that portion which is below the lower rim of the alveolar plate, as represented here (indicating). The *body* of the peridental membrane, which means that portion extending from the lower rim of the alveolar plate to the end of the root. The third, the *apical* portion, is that portion which occupies the apical space proper. So in referring to this membrane in the future these three expressions will be used when it is desired to refer to any particular part.

The diseases of the peridental membrane to a certain extent we have considered. Those forms of inflammation which have their origin in the apical space we have had more or less to say about—apical pericementitis and an extension of the inflammation into the body of the membrane, resulting in general pericementitis; and you will remember I asked a question in our recent review about the treatment of a case of general pericementitis. I won't say anything on that point just now. But the thought which I want to bring out now is that these forms of inflammation or disease which we have previously considered, are the ones which have their origin in the apical space, the tissue in the apical space, for instance, having been irritated from the products of a dead pulp or infectious material. There are diseases of the peridental membrane which have their origin at the gingival margin. These may be divided into three classes: Simple *gingivitis,* which means only inflammation of the gingival portion of the peridental membrane; *calcic inflammation,* which is inflammation of the organ brought about by the accumulation of calcarious deposits. This may be in the mildest form confined to the *gingival* portion of the membrane; it may extend, and more frequently does extend throughout the body of the membrane. And the third form of disease having its origin at the gingival margin is called *phagedenic pericementitis.*

Simple gingivitis may be brought about from many various causes. There are lots of constitutional disorders which bring about gingivitis. As I stated a while ago, iodine taken into the system is thrown off by the lymphatic vessels of this organ, exuded under the free margin of the gum, and will cause gingivitis. Not only iodine, but other drugs, such as mercury, cause gingivitis, and this latter may cause general inflammation of the membrane—salivation from mercury. A small quantity in the system may result only in the production of simple gingivitis. Lead also will be thrown off by this system of vessels, irritate the tissue about the neck of the tooth and set up a gingivitis. Phosphorus will also produce the same result. Whenever it is determined definitely that gingivitis is the result of constitutional disorders, similar to those just enumerated, of course the treatment must be principally of the systemic order. Local treatment will simply result in temporary relief, so long as the poisonous elements are in the system, and are thus being cast off in this position, so that constitutional treatment must be resorted to in order to effect a positive, permanent cure. The cause of gingivitis very frequently, and perhaps more frequently than otherwise, is the result of local irritation—the accumulation of what is termed serumal calculus. More will be said on this substance a little farther on. This accumulates always under the free margin of the gum at first. Serumal calculus never accumulates on the exposed surfaces of the tooth; always underneath the tissue. And while these lymphatics are thus engaged in throwing off the poisonous products of these drugs or other elements in the peridental membrane, they exude a serum which is not normal, which is in a pathological condition, to a greater or less extent; and also the serum from the blood is in a pathological state, and it is the teaching at the present time that this form of calculus is thus deposited from these pathological forms of serum. It accumulates in flat, thin layers under the thin margin of the gum, and thus results in irritation and inflammation. Whenever this is the cause the treatment indicated is a thorough, positive removal of the deposits, and if there is nothing else irritating the tissue, that is all the treatment indicated; the tissue will return to a normal state just as soon as the deposits are removed. The irritation may be from an injury by an instrument. Very often instruments slip in our fingers, perhaps more frequently than they ought to, and irritate the soft parts about the neck of the tooth. I have seen severe forms of gingivitis inaugurated from this cause, especially when a little infectious material is carried into the parts by the instrument. It may be from acid saliva, or an abnormal condition of the saliva. This may be said to be quite a frequent cause of gingivitis. When it is so recognized the treatment must be in the direction of correcting the abnormality of the saliva, and causing it to return to a normal condition.

TWENTY-SECOND LECTURE.

Pathology and Therapeutics of the Peridental Membrane—Continued.

Gingivitis—(Continued). There is another local cause of simple gingivitis that I want to call your attention to, and that is the accumulation about the margin of the gums and underneath them, and the retention in this position, of micro-organisms. And this is, in some mouths, a frequent cause of gingivitis, particularly in the mouths of individuals who are not especially particular about cleanliness of the teeth. Very frequently we see an accumulation of micro-organisms and soft particles of food about the margins of the gums and the latter tissue, in consequence, more or less inflamed. This material, whenever found under these conditions, will always be soft. It is not necessary that there be an accumulation of serumal deposits or any other form of hard deposit in connection with this class, but the gingivitis is brought about simply by the irritating effect of the micro-organisms and the poisonous products they give off. The treatment under these conditions is simply a removal of the irritating materials and the use of some stimulating antiseptic, some of the stimulating essential oils, and the instruction of the patient to be more careful in the future about the cleanliness of the mouth generally to prevent a recurrence.

There is another cause of gingivitis other than those already mentioned, and that is the accumulation upon the necks of the teeth of that form of calculus called *salivary*. You will remember we spoke briefly about serumal calculus, but that form of calculus which accumulates upon the expased surfaces of the crowns of the teeth is salivary. Remember the statement that serumal calculus never accumulates upon exposed surfaces of the teeth, but always underneath the tissues. Salivary calculus always accumulates upon the exposed surfaces of the teeth. The accumulation of this deposit at first may be very slight about the neck of the tooth in close apposition to the gum margin, and if neglected it continues to accumulate until we may see present almost any amount of salivary calculus upon the surfaces of the teeth. Whenever present, even to a slight extent, it is very liable to inaugurate gingivitis more or less severe, because it is true that soft tissue cannot retain its healthy normal condition when brought in contact with salivary calculus. The substance seems to possess a peculiar destructive property, or element, that is sure death to the soft tissue when placed in contact with it under these conditions. The layer of epithelial tissue of the mucous membrane of the gums is destroyed, thus leaving a space of more or less extent, and in that space more salivary calculus is deposited and another layer of soft tissue in consequence is destroyed, and so the process continues until, as we shall see, there may be destruction of the parts to any extent. In this connection I will pass this specimen around so that you may all have an opportunity to see it. After you have seen this specimen of salivary calculus, I think you will be in a position, mentally, to believe almost anything I may say upon this particular point. This was sent me by a gentleman in Wisconsin, some four years ago, and was taken from the mouth of a lady in connection with several other teeth. It was a lower lateral incisor tooth. You will see on one side the incisal edge of the tooth; you will see on the opposite side the apex of the root, all the rest being covered with the accumulation of salivary calculus. It may be that some of you have seen specimens just as bad as this one, but I presume many of you have not.

You will remember what was said regarding the source of serumal calculus. As to the source, or more especially as regards the manner of deposits, of salivary calculus, I might occupy considerable time considering the theories and ideas of investigators from early days down to the present, but will not do so, because after we have considered these theories carefully we would know little more about the facts than we do at the present time, and our knowledge at the present time on this phase of the subject is not satisfactory to a great many. However, the generally accepted theory of the source of salivary calculus is this: We know in the first place that it comes from the saliva; that point is definitely settled, and nearly all agree upon that particular phase of the question, that it is an ingredient of the saliva, being present in the saliva as this substance flows into the mouth from the various sets of salivary glands. But this point, why some individuals are troubled to so great an extent with the accumulation of salivary deposits, while other individuals are troubled but very little, if any, is a question upon which all are not agreed, or in connection with which all are not yet satisfied. Some give one theory, some another. You will remember that Prof. Black tells you that this is largely hereditary, this matter of salivary calculus, and to me this theory seems as plausible, or more so, than any other that it has been my pleasure to consider, for we know that a great many ailments, similar to this difficulty, are hereditary, transmitted from the parent to the child, and it seems just as reasonable to suppose that this condition may be transmitted as well as any other condition. But we shall have to leave that particular point somewhat in doubt.

How are these lime salts held in the saliva is an important question. You will all agree with me when I say that the salts of calcium are almost absolutely insoluble in water, and saliva, as you well know, is very largely composed of water. Then how are the salts of calcium carried by the saliva?

Let us look into the composition of saliva, and I think it will prove interesting if you are not already familiar with it. At any rate, I want you to have it in your lectures so you can refer to it in the future, if you wish to. What I will give you is the average of a great many analyses that have been made, by reliable chemists, of the saliva when in as nearly a normal condition as it was possible to get it from patients' mouths:

Of water	994.10
Of solid constituents	5.90

There are some elements included in what is termed the "solid constituents," which virtually are not solid elements, but they are given in that form for convenience. The various elements constituting this quantity, 5.90, termed solid constituents of the saliva, are individually:

Epithelium and mucus	2.13
Fatty substances	0.07
Mucin and traces of alcoholic extract	1.41
Sulphocyanide of potassium	0.10
Chloride of sodium, chloride of potassium (?) Phosphates of the alkalies and earths and oxide of iron	2.19

Aside from these elements the saliva contains small quantities of nitrogen and oxygen gases. It always contains, in addition to these two gases, large quantities, or we might say an abundance, of carbonic acid gas. Carbon dioxide is one of the natural, so to speak, constituents of the saliva. It is present in the saliva in large quantities, as the latter flows into the mouth. You, no doubt, have learned from your work in chemistry that the salts of calcium are freely soluble in carbonic acid gas. It is this element in the saliva that holds the salts of calcium in solution. The carbonic acid gas dissolves the lime salts in the system, it is brought to these various salivary glands; and it then passes with the saliva into the mouth. It is not proper to state, however, that the salts of calcium are held in solution in the saliva. This is an important point. Never speak of these organic solids of the saliva as being held in *solution in the saliva.* They are dissolved by the carbonic acid gas, and are held thus in *suspension in the saliva.* That is a little technical difference that is important, and when you come to write articles for publication in the journals in the future, and refer to this subject, I want you to remember this particular point.

Another important question presents. How are the salts of calcium left free to become deposited upon the teeth if they are held in suspension by the carbonic acid; why are not these salts passed out of the mouth as the saliva is ejected from the mouth or is swallowed? You also know that there are many substances which have a great affinity for carbonic acid gas, which enter into combination with it whenever opportunity presents, and thus combining with the carbonic acid gas take the latter away from the saliva. One of these gases, which is generated in the mouth, oftentimes to great extent, and which has strong affinity for carbonic acid gas, is *ammonia* gas, which is generated from the decomposition of nitrogenous substances generally in the mouth. There are others, no doubt, that take up portions of the carbonic acid, but this is the principal one. No doubt more or less of the carbonic acid escapes into the atmosphere without having combined with any other gas. The ammonia gas gets into combination with the carbonic acid gas, thus taking it out of the saliva. This leaves the lime salts, with which the ammonia does not combine, in the mouth. They must become deposited somewhere because they cannot remain in solution in the saliva after the saliva has been robbed of its carbonic acid gas; hence the accumulation of this substance upon the teeth.

Speaking of this condition being hereditary, it would seem that something by way of constitutional treatment might result in some benefit, but there is no efficient form of constitutional treatment known to us at the present time; many forms have been tried, but none with any marked degree of success, so that it is not worth our while to consume time upon this particular point. On the other hand, by way of local treatment, it would seem perfectly reasonable that some form of mouth wash or local treatment, by way of thorough cleanliness, etc., with the view of preventing the formation of ammonia gas in the mouth, would go a long way toward preventing the accumulation of tartar upon the teeth; and this is true very largely. If this matter of cleanliness is given special attention, the prevention of the formation of ammonia gas in the mouth is looked to carefully, you will do a great deal oftentimes by way of preventing deposits of salivary calculus upon the teeth. However, I know many; and when I say many, it is true, and Prof. Black has told you in substance the same thing, I think, that while it seems that this is a hereditary disease—we may call it a disease—he knows many individuals, whose parents were troubled almost to the point of exasperation during their lives with the accumulation of salivary calculus, but whose children oftentimes were not troubled with it to any extent. So that if it be a systemic condition it cannot be put down dogmatically as holding good in all instances. But Prof. Black has told you from years of observation, observation of a great many cases along this line, that his only conclusion is that it is very largely hereditary.

As to the various locations in the mouth in which we find salivary calculus present. The saliva flows into the mouth, as you well know, from various sets of glands through various ducts. There is a duct opening from each cheek about opposite the first upper molar tooth, leading from the parotid gland, called Steno's duct. The ducts from which the larger quantity comes into the mouth are underneath the tongue, Wharton's ducts. The saliva flowing principally into the mouth in this region underneath the tongue, naturally the lingual surfaces of the anterior lower teeth are constantly bathed with a larger quantity of the fluid than are the surfaces of the teeth in other parts of the mouth; hence, it would naturally follow that the larger accumulation of this deposit would occur in this position. The buccal surfaces of the upper first molars, second molars and bicuspids being constantly bathed with the saliva from those ducts we naturally look especially to this position as another location for the accumulation of salivary calculus. However, it is by no means confined to these localities because we find it accumulating upon all the teeth, upper and lower. The upper anterior teeth perhaps are the ones which are the least affected by the accumulation of salivary calculus.

As to the consistency of this substance; we find it in all degrees, from that which is soft to that which is exceedingly hard, oftentimes seeming to be nearly as hard as the tooth structure itself. As to just why this is so I will not make any positive statement, because we do not know positively. No doubt it is due very largely to the relative proportions of the elementary constituents of the substance. And that brings us to the thought as to what are the elementary substances, making up this material, salivary calculus. And an average which is the work of reliable analytical chemists, of a great many different specimens of salivary calculus, from the soft to the hard, from the mouths of men, from the mouths of women, and from the mouths of young people and children, is this:

Water and organic matter	22.07
Magnesium phosphate	1.07
Calcium phosphate	67.18
Calcium carbonate	8.13
Calcium fluoride	1.55

Thus you see of the various salts of calcium the phosphate very largely predominates.

As to color we also find a great variety in salivary calculus. We sometimes see it very light in color, however, always possessing a yellowish tinge. All the way from very light to very dark, black, especially in the mouths of men who chew tobacco, more than smoking, do we find the tartar very dark in color, no doubt owing to the stain of the tobacco being absorbed by the tartar. Smoking affects it in this respect more or less, but, as stated, not nearly so much as chewing. Other local conditions, and no doubt some constitutional disorders, general debility of certain characters, are largely influential in imparting the various colors to this substance. It is not necessary that we spend further time on that, although a great deal might be said; yet, I feel that it is not of as much importance as something else.

As to the extent of the accumulation of this substance we have already said a few words. We may find it accumulating only upon one surface of the tooth to a slight extent. For instance, the lingual surfaces of the lower anterior teeth, while upon the proximal and labial surfaces there may be found none of it. We may find it upon two or more surfaces of the teeth and another surface or two to be free from it. We may also find it entirely encircling the crown of the tooth, about the free margin of the gum. Whenever present to a slight extent it is always a source of simple gingivitis. Whenever found to a great extent it produces more grave results, such as general inflammation of the peridental membrane. And in the destructive process of the tissue by salivary calculus, as referred to a moment ago, the destruction is not only confined to the soft parts, but the bone, the rim of the alveolar plate of bone, will be destroyed. The gum tissue is progressively destroyed layer by layer until the periosteum, the peridental membrane at the rim of the alveolar plate of bone, is reached and is also destroyed; and after this is destroyed the source of nourishment for that portion of hard substance is taken away, so there is nothing left for the rim of the alveolar process except to be absorbed through the influence of those little cells whose business it is to destroy bone—the osteoclasts. And as you see in that specimen which I handed you, it may thus continue throughout the entire circumference of the root of the tooth until the process of bone is destroyed almost if not quite to the end of the root.

It is a characteristic of this substance when accumulating upon the teeth and causing destruction of these parts not to work in a narrow pocket along one side of the root, or not to cause a destruction of tissue to any great extent upon one surface of the root of the tooth. Sometimes you will see specimens where the tartar is destroying the tissues along one side of the root and will progress half or two-thirds the way to the end of the root, and no destruction having occurred on the opposite side, but such instances as these are rare exceptions. Whenever destruction thus obtains to any extent you will find the tartar accumulating throughout nearly the entire circumference of the tooth and the destructive process progressing upon all sides of the tooth.

Another characteristic in connection with the parts which are destroyed thus by salivary calculus is this: As you reach the under surface of the calculus, or that surface which is nearest the apex of the root, the soft parts, the peridental membrane, are intact with the cementum, almost close to the surface of the tartar itself. There is no progression of the destructive process underneath the tartar at any one point to any extent. This is not true in connection with other forms of disease of the peridental membrane which will follow later on.

The treatment of salivary calculus is very largely mechanical in nearly all cases. By that we mean all that is indicated or is necessary is a removal of the tartar with instruments. It is not wise to resort to the use of *acids* for the purpose of dissolving salivary deposits, or serumal deposits, for that matter, from the roots of teeth. I mention this point especially because it has been the teaching and is the teaching at the present time of some (however, I am happy to say their influence in this direction is not great in the dental profession; otherwise, much damage might result), that the use of acids for the purpose of dissolving this substance is the thing to be resorted to. If acids are used in sufficient strength and sufficient quantity and for a sufficient length of time to effect a dissolution of tartar upon the teeth to any extent it certainly will result deleteriously to the tooth structure itself; so that this should not be resorted to. But with your instruments remove it thoroughly whenever found, and it is just as necessary that every little particle be removed as it is that germs be destroyed before you can hope to effect a cure of an abscess, or anything of that nature. For if there remains the minutest particle of either form of calculus in contact with the soft parts it remains there simply as a source of irritation, and the soft parts continue to be irritated and more or less inflammation will continue to be present.

As regards the instruments, the forms, etc., best suited to the removal of these deposits, I will not speak because that belongs to another department. But let me say just this in this connection, especially when working in narrow pockets along the roots, such as are formed by phagedenic pericementitis, and there is present more or less serumal calculus. Let the instruments under these conditions be as narrow and thin and flexible as possible so that they will themselves pass readily into these pockets without lacerating the soft parts on either side of the pockets. You will all agree with me that it is impossible to work with any degree of comfort to the patient or satisfaction to the operator, in these pockets along the roots of teeth, with large, blunt, inflexible instruments. Occasionally we see in the infirmary an attempt on the part of someone to remove these deposits in these long narrow pockets with these large, unwieldy instruments. They simply tear into the soft parts as they are pushed into the pocket and cause by this means unnecessary pain. So if your scalers are large and inflexible and thick, such as the majority of them are when you first purchase them,—and I believe you have been advised very largely to purchase the Harlan set,—there is scarcely an instrument among them except is too heavy in all its aspects when it comes to you from the dental depots. Grind them down if you can't buy any made to suit, so there will be what they should be for these purposes.

In addition to the mechanical treatment (or the removal of the deposits) of the disease which is induced by the presence of salivary calculus, and which disease we shall term Calcic Inflammation, sedatives which are antiseptic locally are indicated. You will remember that of the essential oils, those agents which we class as essential oils, those which act especially as sedatives to the soft parts are only two in number, the principal one being oil of cloves and the other beechwood creosote. Any other preparation that is an antiseptic and a sedative may be applied to advantage. In severe forms of pericementitis from this cause you will remember the application of carbolized hot water for some minutes is one of the best forms of local treatment that can be used.

In the use of counter-irritants, such as aconite, iodine and chloroform, it should be applied about the edges or the circumference of the inflamed area. When thus applied it serves to scatter the inflammation, to draw it away, so to speak, from the central portion of the inflamed area, and acts better than it does to apply it directly over the inflamed parts themselves.

In severe cases, systemic treatment, as previously considered in this connection, may be used to advantage.

TWENTY-THIRD LECTURE.

Pathology and Therapeutics of the Peridental Membrane—Continued.

We were speaking in the last lecture of the necessity of the thorough removal of calculus and how it could best be done, the only means referred to being the use of instruments. A great deal can be done by the proper use of a tooth brush in the direction of preventing the accumulations of salivary deposits, although this means will not be successful by way of preventing it entirely, by a long ways. However, if individuals use the brush intelligently and thoroughly it will assist materially in preventing the accumulations of this material. And, by the way, it may not be out of place to state that the bristles of a tooth brush should not be stiff and rigid, but as a rule what are called the medium. It will be better, on the whole, to use the soft bristles instead of the hard. The medium serves the purpose in the majority of instances better than either of the other two. And it makes a difference how the brush is used in order to get the best results. The brush, as a general thing, should not be used in a horizontal direction; that is, brushing crosswise at right angles to the long axis of the teeth. This motion will simply serve to remove accumulations upon one surface of the teeth, possibly two, the labial or buccal and lingual. And how frequently we observe individuals using the brush simply with that one movement. You should instruct your patients differently. The motion of the brush should be parallel with the long axis of the teeth. In the upper teeth, the bristles pressed well against the teeth so that they are pressed as well as may be into the interproximate spaces, and then with a downward sweep from the gingiva to the incisal edge; the lower teeth in the same manner, from the gums to the incisal or occlusal surfaces. This will serve to catch particles of food that have lodged between the teeth and more completely remove them than any other movement. This should be observed both on the labial, buccal and lingual surfaces.

One cleansing of the teeth, or one operation for the purpose of the removal of calculus, if the case is at all bad, is not sufficient. A patient should never be dismissed with one sitting for this operation. If any of you have never tried it, the next case that comes to you for treatment take all the pains and time that you possibly can at the first sitting; remove the deposits, as you think, as well and completely as you can; dismiss the patient and after two or three days have him come back and look again, examine closely and you will be surprised at the number of little particles of deposits that are still remaining on the teeth, and those, too, which you have overlooked at the first sitting; they will not, as a rule, be deposited there during the two or three days' time in which the patient was absent. And if you are not satisfied with the second sitting, have the patient come the third time. More than once I have had the patient come back at least six times, so that I might feel perfectly sure that all the deposits had been removed. This is a matter of much more importance than the average practitioner ascribes to it. This extreme care is necessary to prevent the destructive effects of this material, because it will reaccumulate in mouths, and in some mouths in a very short time, and you will find a great diversity of things in this connection in different mouths of the same family. By way of illustration, let me tell you this: I know a family, two daughters of which have to have salivary calculus removed from their teeth at least every two months, sometimes every month, it accumulates so rapidly. A brother in the same family has never been compelled to go to the dentist but once in his lifetime for the removal of salivary deposits, and he is now in the neighborhood of thirty years of age. So after you get out into practice and become acquainted with your patients, those in the mouths of whom this substance is prone to accumulate, educate them along this line—to come every three or four months, or six months, or every year, as necessity arises, so as to keep the teeth free from this substance. If neglected, as we have seen, it results only in the destruction of the attachment of the tissues to the root of the tooth and becomes a very grave matter.

There is an important phase of this question, and that is this—to what extent, as a general thing, may the tissues about the root of a tooth be destroyed and yet render it at all probable that that tooth may be treated and retained and made useful? As the destruction of the attachment of the parts about the root of the tooth progresses, of course, the tooth becomes loosened, and oftentimes to a very great extent. One peculiarity in connection with this substance I mentioned the other morning, that as a general thing the destruction of the parts about the root of the tooth does not progress to any great extent more rapidly or to a greater distance than you find the accumulation of the tartar itself. The most extreme case in which any considerable number of teeth have been retained and made useful in the mouth, that has come under my observation, perhaps, is this: A lady about forty years old presented with salivary calculus accumulated upon all the teeth in her mouth. She had probably half the original number of permanent teeth left, and in connection with most of the teeth remaining the destruction of the parts had been carried on two-thirds the distance to the ends of the roots, so that about only one-third from the apex of the root was remaining in the socket; some of the teeth a little more than this, but not many. The teeth were very loose so long as the tartar was intact, but upon the thorough removal of the tartar and the treatment of the soft parts, the inflammation subsided, and with the use of astringents the tissues were caused to tighten about the roots of the teeth and they became reasonably firm. That lady has had these teeth now in that condition for the past four years and they are reasonably firm and are doing reasonably good service. But as a general thing, when the parts are destroyed about the roots of the teeth to this extent, two-thirds the distance to the ends of the roots, you will find it necessary in the majority of cases to extract. If only half the distance has been destroyed, and the case is not complicated with phagedenic pericementitis so that pockets are extending from that surface on to the apex of the root, or nearly so, in nearly all cases the teeth can be properly treated and made useful for a considerable length of time. Of course, there are other conditions present which oftentimes will make it more advisable to extract a tooth under these conditions which otherwise might be retained; cases for bridge work, plate work, etc.

The tissues about these teeth, once destroyed, never return. The gum tissue destroyed to any extent, especially in cases where it has gone so far that the peridental membrane is involved, that the alveolar plate of bone is involved and a portion of it destroyed, those parts will never be restored in the future. All that can be done is a removal of the deposits as found, causing the inflammation through proper medicinal treatment to subside, causing the soft parts to constringe about the roots of the teeth; diligent treatment in the future, to keep the parts healthy; that is all that can be hoped for.

A gentleman, some one and a half years ago, read a paper before one of our local societies, and presented models demonstrating his method of treatment for the purpose of causing the soft parts, the gum tissue about the necks of teeth, to be restored, to grow back and fill the interproximate space and occupy the position, if possible, that is formerly occupied while in its normal condition. I want to tell you about this because I have just made the statement that the parts will never return. They can be caused to return to a certain extent by a certain process, but the growth is not a normal growth; it is not a healthy growth of tissue, and when the exciting causes which have induced it have been removed the tissue invariably will absorb and return to the former position before these exciting elements were applied. He uses little rubber plates made to fit the case, with metallic bands fitted about the teeth and vulcanized into the plate; then he cuts out a portion of the rubber about the necks of the teeth, so as to represent the space as nearly as may be in which he wants the soft parts to fill in. Then by scarifying the gum tissue, by using medicinal irritants, such as nitrate of silver (this being his favorite), in the proper per cent solution, the edges of the gum are thus scarified and irritated, and these plates kept in place so as to prevent the passage of materials into the space, and are thus continued. I have seen the gum tissue, I have caused it myself to reproduce itself to a very considerable extent, and after the operation is completed and the little plates are removed, it oftentimes looks very well and certainly appears as if one had succeeded in causing a growth of tissue about the necks of the teeth that will remain and do good service in the future. But, as I stated before, it is not a healthy normal growth and it will not remain intact any length of time. The exciting causes removed, the soft parts absorb again and the case returns to its former condition.

Another point which I wish to impress upon your minds in this connection is the necessity of careful, thorough examination for deposits of tartar, especially of the serumal variety, in the mouth of every patient, especially every new patient that comes to you for treatment. Serumal tartar oftentimes accumulates underneath the free margin of the gum to a great extent, none of it being exposed so that you can see it with the naked eye; but whenever present in this manner for any length of time the gum tissues become more or less inflamed at the margins, and by careful observation you are able to determine at once that something, at least, is wrong. You should examine the mouth of every patient that presents, for these deposits as carefully and as thoroughly as you examine the teeth for the existence of carious cavities. Possibly the greatest number of teeth that are lost from any of these causes are lost from the destructive effects of tartar of one form or the other, principally salivary. So that I feel that I cannot too thoroughly impress upon your minds the importance of care in connection with this work.

As to the condition of the parts in connection with severe cases, we have in a disjointed way, so to speak, referred perhaps to all of them, but where tartar has accumulated about the teeth to any extent there is always pericementitis, inflammation of the soft parts about the root of the tooth; not confined especially to the peridental membrane, but the gum tissue oftentimes will be severely inflamed. Because of the inflammation and the swollen condition of the fibers of the peridental membrane, especially, there is always more or less looseness of the tooth, and very often this looseness is extreme; the tooth will rotate in its socket and move about in all directions freely. In this connection something else should be resorted to, in the treatment of cases of this kind, where looseness exists to any extent. These teeth should be ligated, either with dental floss or with very fine silver wire; or, if these means are not successful, small bands of gold or platinum should be carefully fitted about the teeth, soldered and cemented in place, so as to hold the teeth firmly in their sockets during the time which you are treating them. The constant movement of the teeth in the sockets from chewing or from the pressure of the lips, the cheeks and the tongue, simply serves to continually irritate the parts and continue the inflammatory movement, whereas, very frequently, if something like this be adjusted, so that the movement cannot continue, the parts will recover in much less time.

There is another thought which comes to my mind in this connection, and especially does this hold good with the lower anterior teeth. Frequently you will find, especially on the labial surfaces, a destruction of the gum and the alveolar plate nearly to the ends of the roots, while on the lingual side there may be little or no destruction of tissue, or it may have progressed considerably. At any rate, two, possibly three or all, of the lower incisors are very loose, seemingly making extraction necessary. Very often, by fitting thin gold or platinum bands well down on the crowns of the teeth and soldering them together and extending so that you have a band about a tooth that is firm on either side, possibly the cuspids, and especially if the patient does not show the lower teeth to any extent; cement the bands in place and by this means you may retain the natural teeth in place for years and they will do good service. Let me mention one case. An old gentleman; a pocket developed along the lingual side of the lower left lateral incisor; phagedenic pericementitis was working in his mouth; this pocket extended two-thirds the distance to the end of the root and the surface of the root began to decay, and before it was discovered the root was nearly decayed through at that portion. The tooth was carefully treated, with a band in place to hold it, and what remained of the root was filled, the apex of the root being removed. In this case on the labial side there was little destruction of tissue; just the opposite condition of things which you will generally see. But bands were fitted to that case and cemented in place five years ago, and that tooth is in place to-day, the band holding it firmly, and is doing very good service.

I go out of our way to refer to this point simply to bring it before your minds, so that you can think on these things as they present themselves, and try and figure out something to save the natural teeth in most cases just as long as you possibly can.

As to the prognosis of these cases of salivary calculus, I presume we have said enough, but just one thought farther by way of generalization, that all cases which are complicated with phagedenic pockets or some other form of destruction of the tissue which extends beyond the under surface of the salivary calculus toward the end of the root; such cases as these are the least favorable for recovery. But oftentimes you will find the destruction of the soft parts and the alveolar plate of bone two-thirds of the distance to the end of the root, and if there were no other complications present, nothing only a destruction of that tissue about the circumference of the root of the tooth by the presence of salivary calculus, it would be a very favorable case for recovery.

There is another condition present with nearly all of these cases and to which we have not yet referred, and purposely so, for you will remember that all these cases in which severe inflammation is present, caused by the accumulation of tartar, we have termed *Calcic Inflammation*. And I have carried this idea through thus far without referring to the other condition, which necessarily always accompanies it, for the purpose of impressing more thoroughly upon your minds the fact that the disease in these cases is inflammation caused by the presence of tartar—*Calcic Inflammation.*

The other condition to which we will refer now is the presence of *pus*. Even though the gum margin is destroyed but to a slight extent by calcarious deposits, in nearly all of them you will find more or less pus present, oozing out from underneath the free margin of the gum, and you will always find more or less pus present if there is any considerable amount of salivary calculus present. But take hold of this thought and retain it—that pus was not present in connection with these cases until after the tartar was present, until after the soft parts had been inflamed by the presence of tartar, until the soft tissue had been destroyed to a greater or less extent, in which condition pus micro-organisms entered and infected the tissue and the processes of fermentation and liquefaction were carried on and pus was the result; just the same process exactly here as in pus formation in connection with inflamed areas in any portion of the system. All these conditions, the presence of tartar, phagedenic pericementitis or, which you see very seldom, flow of pus to a certain extent from the free margin of the gum in the absence of calcarious deposits; all these conditions in which pus is present are commonly referred to by the vast majority of the dental profession as *pyorrhea alveolaris*, this being the expression used to designate the certain form of disease present and used in a general way to include all of the pathological conditions that are present. I want you to get a different idea from this in this connection. We believe that it is not proper, strictly speaking, to call this condition of things *pyorrhea alveolaris* and let it go with that one thought, and for the reasons that I have just stated. Any condition where *pus* is flowing from the free margins of the gums may just as properly be termed a case of *pyorrhea alveolaris* as these conditions where tartar is present. Occasionally you will find a blind abscess, the pus of which has burrowed along down the side of the root between it and the alveolar plate of bone and discharging about the neck of the tooth, instead of having burrowed out through the plate of bone and discharging underneath the lip. That is a case in which *pus* is flowing from the gingivæ just the same as it is when it is flowing from the part in connection with calcic inflammation, and a condition of that kind is just as properly, I think, termed a case of *pyorrhea alveolaris*, as is the other. So, whenever these various pathological conditions are inaugurated through the destructive effects of calcarious deposits, call the disease *Calcic Inflammation*; let the presence of *pus* be designated simply as a condition accompanying the disease, just the same as the destruction of tissue is a condition accompanying the disease. There are other names that have been used in connection with this trouble, which, however, are more or less obsolete. *Riggs' Disease* is one expression that you very commonly hear in certain sections, being called this after the name of the individual who is given credit of having first described this condition of things in the mouth, Dr. Riggs. Some have termed the disease *Aveolo-pyolitis*, and various expressions have been used.

As to the teaching of the dental profession generally in connection with the *cause* of pyorrhea alveolaris, so-called. I will use that phrase, if you will permit me, more or less, in our lectures for convenience's sake. If I ever allow myself to omit the last two words, "so-called," please correct me. You will find at the present time, and you will find in the literature of the dental profession, especially in the last three or four years, the idea advocated that the cause of this disease is always constitutional; the causes are to be looked for some place in the general system. Many able men in the profession have written able articles, endeavoring to prove the position which they take in this respect to be the correct one. The vast majority of the dental profession, however, consider that this disease is brought about simply by local conditions, such as we have outlined. And the very ablest authorities along this line, I am glad to state, do not accept the constitutional theory as being proven by any means, but ascribe the formation of pus, which gives it the name *pyorrhea*, to local causes; some form of irritation that is inaugurated about the margin of the gum and causes the tissue to be destroyed and thus infected with micro-organisms and pus resulting. There are, as we have hinted, certain constitutional disorders that no doubt affect this condition of things, and no doubt serve in a measure to keep up the formation and flow of pus about the gums. You will remember that I referred to the use of mercury systemically, the patient being salivated, as causing inflammation of the free margins of the gums, and if the patient is salivated to any great extent severe pericementitis and inflammation of the gums result. Pus very frequently forms in connection with these cases to a great extent and the teeth are very frequently exceedingly loose because of these conditions, which have been occasioned by the effort of the glands of the pericementum to throw off this poisonous element in the system. You will remember that I referred to iodine, to a certain extent causing the same condition of things; and phosphorus and lead. Any poisonous drug, when taken into the system, often does cause more or less inflammation of these parts. But we are not warranted in saying that the formation of pus is due exclusively to the systemic causes. In my judgment, these irritating poisons place these parts in a condition more or less diseased, so that they do not possess the ability or the power to resist the inauguration of these various forms of disease. Thus these poisons act in the system as a predisposing cause, simply rendering the parts more liable to the inception and progress of the disease. It is also true that individuals suffering from the presence of uric acid in the blood, individuals of gouty diathesis, individuals suffering from scrofula, are more liable to the inception of pyorrhea alveolaris, so-called, than otherwise. And there is no doubt but that a continuation of the systemic disorders along these lines serves to continue the local disease and renders it more difficult of correction. And it is true that individuals suffering from these systemic troubles, and also suffering from the local disease, when being treated for the systemic difficulty, the local treatment succeeds in a more marked degree in eradicating the local manifestations of disease.

In regard to the systemic treatment of these various forms of diseases, etc., we will consider that separately under the head of systemic treatment.

What shall be our treatment now for the correction of the pus present? One of the best remedies to use after having thoroughly removed the hard deposits is pyrozone, 3 per cent, or peroxide of hydrogen, any of the best preparations, for the purpose of thoroughly washing the parts and the pockets, with a blunt-pointed syringe that will pass into the pocket and wash all the debris and blood clots and everything of this sort away as thoroughly as may be. One grain of bichloride of mercury to each ounce of the medicinal agent makes an excellent solution. The bichloride adds materially to its antiseptic powers. However, as we shall see when we come to take up our tests in bacteriology, bichloride of mercury in the presence of albumin is almost useless, rendered inert, the albumin destroying the potency of the bichloride. But oftentimes, after you have finished scaling these cases, there is not much albumin left, sometimes not much of anything else, especially, that would act deleteriously upon this solution.

One of the most important forms of medicinal treatment is the thorough use of sedatives, those also possessing antiseptic properties. And one form will be the carbolized hot water, thrown upon the parts vigorously for a few minutes' time; this will do perhaps more by way of reducing the inflammation than any other local agent that may be used. Let me caution you against the use of one drug especially in such conditions, as it is one which many are prone to use and advise the use of, and that is tincture of iodine. Where the soft parts are robbed of their epithelium, where the parts, to use a common expression that you can all understand, are raw, tincture of iodine should never be used. It is under these conditions irritating, and not only that, but its action very largely is in the direction of causing the tissue to absorb, contract, recede. So that this, unless the conditions are such that we especially want the action of an agent of this character, should not be used; whenever the gum tissue about the necks of the teeth is swollen badly, is everted, raised away from the teeth, so to speak; and sometimes you will find cases where the gums have become hypertrophied to the extent that they are nearly level with the incisal edges of the teeth. This occurs in connection with the lower anterior teeth. You will not see them hypertrophied to this extent very often, but occasionally you will. And whether there is pus present or not under this condition, we want the action of a drug that is a powerful astringent as well as an antiseptic. Tincture of iodine here may do some good, but the drug par excellence in this condition of things is *sulphate of copper*, finely powdered. After the deposits have been removed and the parts have been cleansed with the liquid solutions, protect the field of operation with napkins, and the powder may be used perhaps better with a piece of orange wood, whittled thin and flat, passed into sterilized water and then passed into the powder; a quantity of it will cling to the stick; pack the powder into the pockets about the teeth thoroughly, and let it rest for five or ten minutes; five minutes, as a rule, will be long enough. Then with the syringe and warm water wash the excess away, dismiss the patient and in two or three days' time you will be surprised to note the extent to which the swelling of the soft parts has been reduced. If need be, repeat the operation. Unless the case is a very severe one, if everything has been done thoroughly, you will find one application sufficient. This drug in full strength, thus used, is a powerful agent, and it should not be used in ordinary pyorrhea pockets, because it is so irritating and oftentimes causes inflammation of the parts, which otherwise would not occur. It is also a mild escharotic.

TWENTY-FOURTH LECTURE.

Pathand Therapeutics of the Peridental Membrane—Concluded.

We will try this morning to finish the subject of diseases of the peridental membrane. First, I want to speak of two cases especially that have come to our notice in the infirmary, each of which was very typical in its class. One, a destruction of the tissues on the labial surface of a lower central incisor, because of the continued presence of salivary calculus and also serumal calculus. The tissues were destroyed to the end of the root, while the attachment of the tissues on the lingual surface was still perfect. However, laterally on the proximate surfaces the destruction of the parts had progressed nearly to the lingual angle. The apex of the root had protruded somewhat, so that a little dent, so to speak, had been produced on the inside of the lip. Of course the root was covered with calculus its entire length; an instrument could be passed under the apex. However, the tooth was not very loose, as would be naturally supposed; the remaining portion of the attachment of the peridental membrane and gum held it reasonably firm in the socket. In connection with the adjacent teeth there was very little destruction of tissue. This tooth has been in this condition, the lady said, for some time. While it is not especially annoying, there is more or less inflammation present in the tissues of the lip in the region of the apex of the root. That tooth, even in that condition, can be retained in the mouth and be made to do good service for a long time. It evidently will remain without any artificial support for some time if it receives proper care—the removal of the tartar, and, if necessary, the excision of a portion of the apex, so as to prevent further irritation of the tissues of the lip—and if the lady will take care of it in the future it will serve her purposes very well for a long time. If necessary, little bands, as spoken of some time ago, may be fitted and cemented to that tooth, including one on either side of it, that will serve to retain the tooth for years. I speak of this because it was such a typical case of the destruction of tissue along the surface of the root of the tooth. A number of the students saw it; I wish all could have seen it.

But one case which I want especially to direct your attention to this morning was a case of *phagedenic pericementitis* which came to our notice in the infirmary. It was an upper left central incisor tooth. An alveolar abscess was the final result and a fistule had formed in connection with the tooth, so that the fistule opened at this point (referring to drawing), more nearly opposite the root of the left central, so that anyone looking at that would take it for granted at once, and be justified in so doing (without further examination), that the pulp was involved in that tooth and that it was simply a case of alveolar abscess, dependent upon the death of the pulp. The demonstrator came to the conclusion that the pulp in the tooth was dead and the student was directed to open on the lingual surface for the purpose of treatment. But upon approaching the dentine it was somewhat sensitive, and, cutting farther, a small portion of the pulp was finally exposed and found to be very much alive. That puzzled them. Then they resorted to the heat test with that and the adjacent teeth and they all responded vigorously, indicating live pulps in all of the teeth. There was nothing about the necks of the teeth that would indicate any disease having commenced at that portion; seemingly, the gum margins were intact and presented a healthy appearance. I was called to the chair and immediately explored the fistule and found that instead of leading to the apex of the root, the opening led into the bone septum between the roots, and upon further examination that bone was found to be more or less carious over a considerable area. Then I examined about the gingival margins of the teeth, and leading from the mesio-lingual angle of the left central a narrow pocket was discovered; one of those thin, narrow, flexible scalers passed readily into it, along the entire length of the root and up into these parts between the roots of the teeth. The attachment of the other portions of soft tissue about the circumference of the tooth was intact. There was no evidence of any pocket in connection with the right central or any of the other teeth; constituting one of the most typical cases of phagedenic pericementitis that has ever come to my notice. I called as many of the students as was convenient to see it, because it is a condition of things that you won't see very often in connection with this disease. I learned afterward that in making a filling some years ago there was an injury to the soft parts at that point on the gingivus, and no doubt this injury afforded a favorable field for the accumulation and retention of that species of micro-organisms which is supposed to be responsible for the inception and progress of this disease, phagedenic pericementitis. At any rate, they certainly accumulated there, and, working along the side of the root, effected the formation of a pocket, and instead of following around the apex of the root and cutting off the blood supply to the pulp, they branched off into the bony septum between the roots, and because of the destruction of tissue in those parts pus formed, and possibly the pocket became stopped or something of that sort, preventing the passage of this waste material about the gingivæ, so that it finally burrowed through the plate of bone and formed a fistule which, as we have stated, presented every appearance of an alveolar abscess. And it is proper to call that condition alveolar abscess, as it presently exists. It is almost everything in the catalogue now connected with these troubles; it is alveolar abscess, it is pericementitis, it is phagedenic pericementitis, it is calcic inflammation, and all the others. Of course, phagedenic pericementitis was responsible for the formation of the pocket along the side of the root. All other soft parts about the tooth were healthy and no looseness of the tooth was present.

There was a little something said regarding the treatment of the hard parts in connection with this disease, phagedenic pericementitis, and this is such an important element that I wish again to call your attention to it in this connection. You will remember the statement that where the bone is destroyed, even the entire length of the root, it may be induced to reproduce itself, and many cases are on record where such results have been accomplished. You see in this picture (indicating) a destruction of the plate of bone about the root of the tooth. Possibly in a case where it is destroyed to this extent, nearly the entire septum between the roots of the teeth, it would form a very unfavorable case for the reproduction of the hard parts; we would hardly expect, as a rule, in a case like that for the bone to be reproduced. But, supposing the septum between the roots was intact and simply the destruction extended along the surface of the root, it may be reasonably supposed that the bone will be reproduced under proper treatment, and certainly will be if the case is properly cared for—or even a case where the bone is destroyed to the extent as represented in this picture (indicating), extending to and beyond the apex of the root. You will also remember that we called special attention to the condition of the margins of bone as frequently left, oftentimes they being enlarged, thickened, more or less everted or rough and jagged. Whenever this condition is present it must be cut away. And in pockets, as represented here (indicating), you will find it almost necessary, in order to work, absolutely necessary, we may say, in order to work with any degree of facility or satisfaction, to make an opening through the soft parts and enter the pocket from that source—a semicircular slit of the gum, as represented by these marks (indicating), lifting the flap of soft tissue away. Whenever the edges of bone in these pockets are perfectly smooth, if they have become enlarged or everted, unless that unnatural condition at the margin is cut away we may say there will never be a reproduction of the bone tissue in that socket. That is an unnatural growth, we might term it a fungous growth, on the margin of the bone, so that it is impossible in the future for healthy granulations to set in. And many cases have been tried, have been experimented with while in this condition, not cutting those enlarged edges away, but leaving them as found to determine whether or not granulations would form and the bone be reproduced; but invariably failure has been the result. But when this unnatural growth is cut away and you cut down to healthy bone tissue, new granulations may be induced to form very readily.

I do not remember whether I spoke of the manner of cutting this tissue or not, but whether I did or not it will not do any harm to repeat. It is rarely ever best to undertake to use the bone-cutting burrs in the engine for this purpose, for the reason, principally, that you cannot control the instrument so well as you can a hand instrument; it is more likely to catch upon some rough place or some projection of bone and pass beyond your control, and thus tear into the surrounding parts and cause further injury, which is very undesirable. So let the work along this line be very largely with hand instruments, sharp chisels or sharp instrument arranged for a pulling motion. If necessary, the chisel may be used with the mallet wherever the conditions are favorable, and it seems more convenient to so use it. But, at any rate, see that all those rough margins of bone are cut away and the edges left fresh and smooth.

After this is done, after all the deposits are removed, the medicinal portion of the treatment is most important. And let us consider for a moment what are the objects to be accomplished through medicinal treatment of these diseased conditions, not only of phagedenic pericementitis, but of calcic inflammation, where pockets of more or less extent have formed, where pus is flowing from the margins of the gums. It is necessary, first, that we use agents that will destroy the germs present, which are constantly causing pus to form: antiseptics, germicides, disinfectants. The next element in these medicinal agents which is desirable and necessary is that of an astringent, and next to the germicidal properties that of astringents is probably the next in importance. So let your selections along this line be those which possess both these properties. If a stimulant or a sedative be indicated select accordingly.

You may think, in the treatment of these diseased conditions, that it is comparatively a simple matter to effect the destruction of the germs in connection with these pockets, but if so, I want to dissuade your minds of that opinion at the very outset. It is not so easy as you may think. While it is easy to destroy all the germs and the material that are in the pocket itself, the destruction of the spores of the germs, which have penetrated into the tissue in the surrounding parts, is a much more serious question. You may wash the pocket thoroughly with a potent germicide and for the time being the pocket itself may be rendered free from the presence of germs, from the presence of pus. But remember at all times that the surrounding parts are competely filled, we may say, with the spores of these germs, and while you may wash one of these pockets thoroughly one day and test its contents the next, and find present no living germs, after two or three or four days you make slides of what you find in that pocket and there will be an abundance of living germs, having been developed from the spores of the germs in the surrounding parts. For this reason you will readily see that it is absolutely necessary to follow these cases closely and not to neglect them until the parts are completely healed, because the germs are being continually generated and passing into the pockets. We might, by way of further illustrating this point, perhaps fix it a little more forcibly in the minds of some of you at least, refer to the old onion beds of our boyhood days. How many of you have ever been sent out to pull the weeds out of the onion bed? I will never forget my experience along that line, I assure you. You pull those weeds, or you take the hoe in the potato patch and you destroy every weed visible one day, and after a few days the onion bed or the potato patch is filled up with weeds to as great an extent as it was at first. You are able to destroy the weeds which are visible, but not the seeds which are in the ground; they continue to grow. Just the same in dealing with these germs in connection with these pus pockets. You must keep at them continually and never let up your vigilance and your thorough treatment until the parts are completely healed. One thing especially necessary to be looked to in these pockets are the blood clots. It is of the utmost importance that all blood clots be cleansed thoroughly from these pockets and all future blood clots that may form be washed away. They form a very inviting field for micro-organisms, the germs fill them up completely, and if not cleansed away they remain there as a hotbed for the development of germs and serve to continue the septic condition in the future. It was supposed in the past by pathologists that these blood clots were organized into tissue, into fixed tissue cells, and formed a part of the future living tissue in the healing of the wound, but that is not the teaching of pathologists at the present time. While the blood clot, if left in the part, will be occupied more or less by granulation tissue, it is finally absorbed and carried away, destroyed, and it requires a whole lot of the energy of this new granulation tissue to bring about that result, to take up and carry away these blood clots, energy that can be used to better advantage in furthering the healing process. For these reasons give them particular attention, and you will find no agent more efficient for the thorough cleansing and destruction of blood clots from these pockets than fresh peroxide of hydrogen; one grain of bichloride of mercury to the ounce will add to its efficiency as an antiseptic. I take time to call your attention to this one particular point, because it is so much more important than the majority of us give it credit of being.

In regard to the selection of medicinal agents after granulation tissue has commenced to form. You should be careful not to use from this point on any medicines that possess the nature of escharotics. At first escharotics are oftentimes indicated to a certain extent, in some cases to a great extent; but, remember, after granulation tissue has commenced to form discard the use of escharotics, because every time they are brought in contact with the newly forming tissue there must necessarily be more or less of it destroyed and a consequent retarding of the healing process. So change your agents to those which are still antiseptic, but which do not in any wise harm the soft tissue when brought in contact with it.

It has been advocated and practiced by Prof. Black, in dealing with these cases, and I have also practiced it myself somewhat, after having done your work through these artificial openings, effected by the slit in the gum, in order to prevent the passage of saliva through that opening and reinfecting the entire pockets, to close it over hermetically by some process, and this process has been used to decided advantage oftentimes; a piece of tissue paper large enough to cover the opening placed over it, the soft parts dried as thoroughly as possible and chloro-percha flowed over that and onto the soft parts about it. This will adhere quite tenaciously and will remain for some time if it is not disturbed, and will serve to prevent the passage of saliva and other foreign material through that opening while the gum is healing. Not only over those artificial openings, but also the entrance to these pockets about the gum margin; the ordinary soft gutta-percha stopping may be molded to fit about the necks of the teeth between the teeth and over the entrance to those pockets and thus left, for the time being, between treatments, and will be very serviceable in preventing a reinfection of the pocket.

In regard to the reformation of the peridental membrane and the bony tissue, etc., there may be a thought in the minds of some of you as to how the peridental membrane, especially, is to become reattached to the cemental tissue, because it has been destroyed absolutely, the surface of the cementum has been bare for some time, and in the reproduction of this soft tissue how will it become reattached to the cemental tissue? There are various theories in connection with this, all of which seem perfectly reasonable; and one in connection with traumatic injuries, or those of recent formation, where the peridental membrane has been destroyed to a certain extent along the cementum, but which condition has not continued long enough so that the cells of the cementum have lost their vitality. In these conditions there is simply a multiplication of the cemental cells which throw out processes that reunite with the granulation tissue of the soft parts. This has been observed and demonstrated by microscopic slides, etc., so that there can be no doubt as to the manner in which reattachment is effected under this condition. But in these pockets of Phagedenic Pericementitis, especially where the destruction of the part has obtained for a long time, and where the cells of the cementum have lost their vitality, so that they are unable to multiply or unable to cause these little processes to be thrown out from their surface; this theory is advanced as to the reuniting of the soft parts with them; that the new granulation tissue of the peridental membrane virtually grows into the canaliculi and lacunæ of the cemental tissue and reinhabits those spaces, and there organizes and thus becomes reattached to the hard tissue. And another theory is this: That the granulation tissue of the peridental membrane grows into the surface of the cemental tissue and absorbs a certain amount of it and reorganizes other portions of it, and thus the reunion is established.

There is one agent to which I wish to call your attention, and with which you are all more or less familiar, in the treatment of pericementitis, inflammation of the peridental membrane, wherever it is possible to use it, and one which as a local agent will do as much, if not more, than any other one in the direction of controlling pericementitis, and more especially is this true in connection with gingivitis, where the inflammation is confined to the parts about the neck of the tooth, and that is an agent which is commonly known to the profession as "Big Nigger." This agent was brought to the notice of the profession by the late Dr. Atkinson of New

York, one of the most prominent practitioners in the profession for years, and was given the name "Big Nigger" by a story which he told in a convention once to illustrate its efficiency. Treatment cases in general were under discussion in the convention and Dr. Atkinson took the floor to speak on the subject. He made a long speech, covering the entire catalogue, almost, of diseases of the soft parts connected with the teeth and of the use of various medicinal agents, and likened this, his favorite, to a big negro whom he saw accomplish what several other individuals had failed to accomplish. One wheel of a wagon loaded with coal had fallen into a gutter, or defect in the pavement, or something of that sort, and there were a dozen or fifteen men gathered about the wagon, tugging and wrestling with it, attempting to help it out, but failed. But along came a great big nigger, who weighed about 300 pounds; he put his shoulder to the wheel, the horses were given the word and out went the wagon. So Dr. Atkinson said, "The same with this agent of mine; whenever I fail in connection with these cases with all others I use this one and succeed." It is a saturated solution of crystals of iodine in beechwood creosote, which you have no doubt used, many of you, in various diseased conditions. Old Dr. Cushing, one of the greatest men that we ever had in the dental profession, and a former instructor in this institution, used to use this mixture in almost all diseased conditions about the mouth where there was inflammation, and especially was it his favorite in dealing with chronic abscesses with fistulous openings. If he failed with everything else he would force this solution through the diseased tract, and claimed that he always healed the case thereby. But I would not advise its use in connection with abscesses in this way. It is not a pleasant agent to use, and in most cases it will discolor the teeth badly, and very quickly, and it is a hard form of discoloration to correct. But where there is inflammation about the peridental membrane, where it can be passed between the tooth and the margin of the gum so as to come in contact with the edge of the peridental membrane, it is one of the best agents that can be used in connection with all of these diseased conditions of calcic inflammation and phagedenic pericementitis.

Another agent to which I wish to call your attention, that may be used much more frequently, is Campho-phenique, a mixture of gum camphor and carbolic acid. You may take equal parts of gum camphor and crystals of carbolic acid, and by rubbing them thoroughly together they form a liquid. I think the proportion that will form the clearest solution is to take 49½ parts of carbolic acid crystals and 50½ parts of gum camphor. This mixture does not possess the escharotic properties of carbolic acid. If confined in contact with the soft parts a considerable length of time, it does whiten the surface of the mucous membrane a little, but I have never known it to destroy tissue unless confined a long time for the purpose of seeing what it would do. It is a sedative, and a valuable one, and for all of these conditions of inflammation it is one of the best and most efficient agents we have. It is also a very efficient agent—to digress a little from the subject—in the root-canals of teeth in connection with apical pericementitis, or a general tenderness and soreness of the parts. I have used it more or less, although not extensively, in the treatment of pulpless teeth, and it is one I would like to have you try in connection with these treatment cases of pulpless teeth whenever inflammation, apical, especially, is present, and watch the results. It is a most potent antiseptic. Its action in preventing the development of germs is not negative, as is that of carbolic acid alone in most instances. I have not, however, carried this mixture to its limit as an antiseptic, but shall this winter, but have far enough to know that it is excellent.

Another thing to be considered in connection with the treatment of these diseases is the use of mouth washes, and this is a necessary part of the treatment. It doesn't make any difference how much time you give to the treatment of these cases, how much time and labor you give in the direction of removing the deposits and the treating of these cases with medicinal agents, unless your patients assist you, unless they resort to every possible means to keep their mouths clean. So always impress upon the minds of your patients the necessity of their coöperation in connection with these diseases—in the treatment of them. Prescribe some efficient mouth wash that they may use, some efficient dentifrice that they may use with the tooth brush. It matters not what particular mouth wash is prescribed so long as it is efficient, so long as it is a good antiseptic and not destructive to the soft tissue. I haven't any pet in this line. We have a number of preparations on the market which are designed especially for mouth washes, some of which are excellent. Two of the most potent by way of antiseptic action, and most desirable by way of other properties, are Sanitol and Borolyptol. Borolyptol, in the past, has been quite acid in reaction, a point in its disfavor, a point to its disadvantage. It is a potent antiseptic, however, and an agreeable one otherwise than the acid reaction. But, I understand, within the past few months that they have changed this condition of Borolyptol and made it a neutral agent. If that be true, it is certainly an excellent one for these purposes. Sanitol is designed especially as a dentifrice, to be used with the tooth brush, athough it may be used in dilute form with water as a general mouth wash. It is a little more potent as an antiseptic than is Borolyptol and I have had my patients use it during the last year in connection with pyorrhea alveolaris, so-called. Sanitol, with the tooth brush, in such cases is certainly productive of excellent results. See to it that something of this sort is used diligently by your patients while you are treating these conditions.

I want to say a few words about the *infectious* character of Phagedenic Pericementitis before we leave the subject. You remember in the early part of our work at the beginning of the term we simply hinted upon this point. But I wish to enlarge a little upon it before we leave the subject so as to impress upon your minds thoroughly the necessity of care at every stage of the treatment of this disease. You will remember the statement that Phagedenic Pericementitis is in all probability the result of the action of a specific form of micro-organism, and if this be true it can be none other than an infectious disease, a disease capable of being transmitted from one mouth to another and from one tooth to another in the same mouth. Experience in practice certainly carries out this theory. I have seen any number of cases of Phagedenic Pericementitis, the history of which from their beginning indicates that their inception was brought about by direct infection with dirty instruments; a case of failure on the part of the dentist to thoroughly cleanse and sterilize his instruments after having used them in the mouth of one patient before using them in the mouth of another patient. And I venture the prediction that before any of you have been in practice many years, you will have the privilege of observing these very results. So always bear in mind that this is, in all probability, an infectious disease, and remember the necessity of thoroughly cleansing, sterilizing your instruments after using them in connection with this disease in any mouth before putting them away. Not only this, but this matter of sterilization should be heeded in your work in general, such as you were told in the beginning of the term. But especially in dealing with this disease exercise the utmost care along this line.

TWENTY-FIFTH LECTURE.

Pathology and Therapeutics of the Soft Tissues of the Mouth.

The majority of cases which we are called upon to treat, as practicing dentists, are probably caused by local conditions. However, some of the most serious conditions that present for treatment are manifestations of constitutional diseases.

The first class of cases I will consider is found especially in the mouths of children, but not always, for we find the same conditions are not infrequently found in the mouths of adults. This condition is brought about purely by a failure on the part of individuals to keep their mouths clean. In this class of cases there is an accumulation of micro-organisms, of mucus, particles of food and other forms of debris, which form a coating over the gums and mucous membrane generally. In dealing with such cases as these usually a good moral effect upon the patient is had by instructing him to secure a tooth brush and a suitable dentifrice to be used diligently for a number of days before giving the case personal attention. If, for any reason, this does not seem advisable, one of the best agents that can be used for removal of these accumulations is peroxide of hydrogen, or some one of the agents of this class, being reduced perhaps one-half with distilled water. This should be used with a pellet of cotton and the pliers, thus thoroughly cleansing the mucous membrane with it. It will cut the material more effectually and cause its removal more thoroughly than any other agent that may be used. The use of pure peroxide for this purpose is not desirable. From pure peroxide are liberated anywhere from ten to fifteen volumes of oxygen which will, under certain conditions, burn or destroy the soft tissues. Diluted one-half there will be from five to eight volumes of oxygen liberated, which amount is sufficient. This agent, however, will not be effective in removing the foul odors from the mouth as will some others. The use of a 2 to 4 per cent solution of permanganate of potassium is very effective by way of removing the odor.

Not infrequently in the use of burrs in the engine, of discs or strips or various other forms of instruments in the hands of careless operators, ugly wounds, giving rise to severe forms of inflammation, occur. Especially is this true if infectious material is carried into the wound by the instrument. And not infrequently, in connection with this form of trouble, much swelling results. The use of hot carbolized water is an excellent form of treatment. This should be thrown upon the inflamed parts for some minutes by means of a syringe, and is especially useful by way of relieving the pain and the congested condition of the parts. The use of a thin paste of eucalyptol and iodol, or aristol, will be beneficial. If the eucalyptol is found to be unpleasant to the taste of any, a small quantity of some other oil may be added, such as wintergreen or cloves, for the purpose of modifying the taste of the eucalyptol. In using this mixture it should be rubbed into the wounded part, carefully but thoroughly, and permitted to remain for a few minutes' time before the saliva comes in contact with the wound. The use of campho-phenique—camphor and carbolic acid—in such cases as these will be very beneficial. As a side thought, this agent will be found to be one of the best in controlling the pain occasioned by the irritation, and frequently the inflammation, arising from the excess of cement forced under the gums in setting crowns and bridges. When used for this purpose, the excess of cement should be completely removed, the gums dried as thoroughly as possible and saturated with the agent for a few minutes. If any have not used the tincture of myrrh for this purpose, you will find it to be an excellent remedy.

In inflamed, swollen conditions of the tissues over erupting third molars, which not infrequently give rise to severe pain, the use of the eucalyptol and iodol, or aristol paste referred to above will be beneficial. This should be packed under the tissue as thoroughly as possible and left for some time. In these cases the use of hot carbolized water, as indicated above, previous to the use of the paste, you will also find useful by way of reducing the inflammation and causing a cessation of the pain. In cases where it does not seem advisable to remove the gum tissue, and suppuration has resulted, the pus must be thoroughly evacuated and the parts treated as indicated above, with the addition of the use of diluted peroxide of hydrogen.

Another condition of the mucous membrane which we are rather frequently called upon to treat, is what are called *canker sores.*

As to the cause of canker sores, I feel warranted in making the statement that our knowledge is not definite. Some claim they are caused solely by local conditions, while others claim that they are manifestations of systemic conditions, especially disorders of the stomach. The fact remains that in connection with their treatment in some cases local treatment is all that is necessary to effectually do away with them, while in others local treatment will do away with them only for a time, when they will recur; and in some of the cases where they show a tendency to recur, certain forms of systemic medication certainly do good, while in other cases the same kind of systemic treatment seemingly has no effect. From this it would seem the above statement that our knowledge as to their cause is indefinite, is a just one.

In mouths in which these sores do not show a disposition to recur, frequently the use of carbolic acid is very efficient in removing them, and if the statement of some be true, that they are caused by an accumulation and retention of micro-organisms on the part, this would seem to be an excellent form of treatment. Stick nitrate of silver, being rubbed into the sore, is frequently effective. When these agents are thus used locally they must be confined to the sore itself, i. e., care must be exercised not to permit the agents to spread over the adjacent parts. Resorcin is also useful in the treatment of many of these cases. When resorcin is used it should be thoroughly pulverized and used full strength; pack it onto the sores, rubbing it in as thoroughly as may be, and let it remain for a few minutes. Tincture of myrrh I have often found useful. A drop or two of oil of cassia used on a tooth brush two or three times a day is effective in some cases in preventing recurrence.

When there is a disposition to recurrence of canker sores, Dr. Black has said that the use internally of oil of cassia is one of the best forms of systemic medication. He tells us that he has succeeded in preventing the recurrence of canker sores in many cases by the use of oil of cassia when he has failed with the use of all other drugs. In using oil of cassia for this purpose twelve to fifteen drops should be put in a half tumbler of water and a teaspoonful taken three times a day before meals. This should be continued, to secure permanent results, for three or four weeks.

More serious forms of trouble of the soft tissues of the mouth which we are called upon to treat are of constitutional origin, and one is occasioned by ptyalism, or mercurial poisoning. This is too frequently one of the most aggravating conditions to treat that we come in contact with. The system of the patient is saturated with the poisonous drug and the soft tissues about the teeth suffer severely in many instances, not infrequently sloughing to a considerable extent, the teeth being entirely lost in severe cases of long standing.

In connection with the local treatment of these cases it is absolutely necessary that the patient receive proper constitutional treatment, which latter should generally be attended to by the family physician.

By way of local treatment, all calcarious deposits or other forms of irritation must be thoroughly removed and the parts be kept free from them in the future. This done, the use of stimulating and astringent antiseptics to keep the parts as clean as possible and cause as much condensation of the tissues as possible, is indicated.

Another pathologic condition of the soft tissues of the mouth is one evidently of rare occurrence; I have seen but two cases like it and have never seen it described in print. In my judgment, the condition is brought about by the action of some specific form of micro-organism. The gums become much swollen. In one instance they were swollen to the extent that the crowns of the teeth were nearly hidden to view. The swollen tissues do not present the appearances of ordinary inflammations; they are white and present a loose, fluffy appearance, not unlike that of light, flaky snow. These conditions come on in a surprisingly short time and spread rapidly to other portions of the mouth. In one of the two cases which I have observed the trouble had its origin about a lower right third molar in the mouth of a lady probably thirty-five years of age. The tooth was somewhat crowded and the tissues in more or less of an irritated condition. The soft parts swelled as described above and included the second and first molars. After these conditions developed in this locality the tissues about the roots of two upper anterior teeth, to which was attached a piece of bridge work, became involved, the swelling extending the entire length of the bridge, covering the artificial teeth about half way to the incisal edges.

These cases were treated in the following manner, and each yielded very nicely to the treatment: The parts were thoroughly cleansed with peroxide of hydrogen, reduced one-half with distilled water, after which they were dried and cleansed thoroughly with a 3 per cent solution of nitrate of silver. Two treatments with these remedies were all that were necessary to restore the tissues to their normal condition.

One of the very unpleasant features in connection with dental practice is the care of *syphilitic sore mouths*, so-called. Syphilis, as we all know, is a constitutional disease, and to be able to unerringly recognize the local manifestations, called syphilitic patches, of this accursed disease of humanity, on the oral mucous membrane, I consider one of the most important of our qualifications as practicing dentists. I believe I am warranted in making the statement that relatively a large per cent of dentists will tell you that they feel positive that they cannot correctly differentiate in the diagnosis of "syphilitic patches" of the mucous membrane of the mouth and some other forms of disease, or of manifestations of disease that obtain. When we consider the awful nature of this disease, and the ease with which it may be transmitted from one patient to another, the necessity to be able to recognize it when present certainly must come home to us with much force. I wish I might be able to impress all with the necessity of studying this disease so that no mistake would be made in the diagnosis of its local manifestations.

It may be stated, as a general rule, that individuals suffering with syphilis will hardly ever escape a local manifestation of it in the mouth; occasionally they do, but the rule is otherwise.

The "syphilitic patches" on the mucous membrane are characterized by a slight raising, or elevation, from the surrounding surface of the tissue. The sores themselves about the edges are slightly raised, and, if of long standing, are more or less everted. A serous fluid is continually exuding from the sore, which, by the way, may be termed the potent source of infection. There is more or less sloughing of the parts and the surface of the sore is continually covered with a slimy mucus, frequently approaching in appearance that of pus. These sores may be pertinently termed ulcerating sores. They may be found on the inner surfaces of the cheek; they may occur upon the surfaces of the tongue or upon the gum tissue, either buccal, labial or lingual, or on the mucous membrane approaching the fauces, and again, they may occur in the same mouth in all of these locations.

In treating such cases as these, during the time that infection is most liable to be transmitted from one to another, we cannot exercise too much caution by way of cleansing our instruments. They must be thoroughly cleansed and sterilized with the most certain means. Absorbent cotton or bibulous paper or napkins and everything of this character should be destroyed. I would advise by way of precaution that no napkin, even, which is used about the mouth of a person suffering with this malady, be sent back to the wash; throw it away or destroy it. Especially is it necessary that we use extreme care in dealing with such cases, from perhaps the fiftieth day after the inception of the disease until the tertiary term of the disease is thoroughly inaugurated. This is the time most likely for infection to be transmitted from one person to another.

Of course, it is absolutely necessary that people suffering with this trouble receive proper constitutional treatment. Local treatment will accomplish almost nothing in an attempt to do away with or to control these sores in the mouth, if the individual at the time is not receiving proper constitutional treatment. These people should always be sent to their physician for the systemic treatment.

As to the local treatment, it is much more simple, perhaps, than many of us imagine. The only thing to be done; in fact, the only thing that one can do, is to keep the mouth as clean as possible. All irritating substances about the gums by way of calcarious deposits, rough edges or margins of teeth that are decayed; in short, anything of this nature that may serve as an irritant to the soft parts, either cheeks, gums or tongue, must be removed. This done, the soft tissues should be cleansed as thoroughly as possible with dilute peroxide of hydrogen. The sores should be thoroughly bathed with a 2 per cent solution of permanganate of potassium, which is an excellent agent for this purpose. The use of the tincture of iodine is always attended with good results. The diligent use of any of the potent, non-irritating, astringent, antiseptic mouth washes is essential. It is almost absolutely essential that the use of liquor and tobacco be done away with. I speak of this because I know it is too frequently the case that the general practitioner does not concede the necessity of this in as many cases as he should. To illustrate: Not long since a gentleman was referred to me by his physician for local treatment for this disease. His physician had been treating him for some time, but had said nothing to him about the use or non-use of liquor and tobacco. The gentleman was an inveterate smoker and was in the habit of cumstances, he evidently wanted too frequently for his own good. The local manifestations in this case were among the taking liquor whenever he wanted it, which, under the cir- worst I have ever seen. At first he was unwilling to discontinue the use of liquor and tobacco. I explained to him the necessity of so doing, but inasmuch as his physician had said nothing about it, he was hardly inclined to accept my judgment. I treated his mouth for a time, but with little success. Finally, I prevailed upon him to quit the use of liquor and tobacco for a time, when I had little difficulty in controlling the local manifestations with practically the form of treatment above indicated.

There is one other condition of the mucous membrane of the mouth to which I wish to call your attention, and, perhaps, next to the "syphilitic patches," it is the most important that we understand. It is an affection called *leucoplakia,* a word derived from Greek characters, meaning in the abstract, *white* and *surface.*

This affliction of the local parts is characterized by the appearance on the mucous membrane, either of the cheeks, of the tongue or of the fauces, of white patches, the surfaces of which are perfectly smooth, presenting somewhat of a glossy appearance. It is stated by some that these patches occasionally occur with a little color, possibly a little reddish or bluish tinge, but before progressing very far they become, in the abstract, a pearly white in color.

The cause of these patches is not well understood; in fact, we may say that we know very little of the cause of this disease. Some ascribe it to certain forms of skin disease, such as psoriasis, herpes zoster, and other forms. Others claim that it is due almost exclusively to syphilis, especially of the secondary character, while others, again, claim that the mucous patches are due almost exclusively to local causes.

It seems to be quite conclusively proven that syphilitic disorders have little to do in the causation of this disease. At the same time, it seems to me we are not warranted in stating that local irritants of various characters are wholly responsible for the beginning of the difficulty; yet, it is true that they play an important part by way of continuing the pathological condition. Many writers upon the subject place the use of tobacco, especially smoking, as an important factor in the causation of the disease, the irritating effect from the volatile and empyreumatic oils liberated in smoking tobacco serving especially to continue the irritation of the parts. Others claim that the use of hot pungent drinks of various characters, also spirituous liquors, are potent factors by way of aggravating the trouble. It is also true that any mechanical form of irritation in the mouth, such as rough margins of cavities, artificial dentures, clasps, etc., coming in contact with the mucous patches, on the surfaces of the cheeks, especially, continue their progress.

As stated above, these patches at first are small. They, however, often spread over the tissue and may occupy an area extending from the corner of the mouth back to the fauces; they may cover the entire dorsum of the tongue; they may include the entire buccal surfaces of the mucous membrane of the gums.

It is important that we be able to recognize this condition, and also important that we be able to correctly differentiate in the diagnosis between this and the patches of secondary syphilis, in some respects the one resembling the other.

I will state in this connection, according to the teaching of some, that there exist two patches of leucoplakia—one of a milky white color, sometimes a little bluish in appearance, which variety, whenever present, is nearly always the result of secondary syphilis. These patches will be somewhat raised from the surrounding surface of tissue, this being one of the chief characteristics of syphilitic patches in the mouth. The other variety, leucoplakia proper, seems to be present and is present in the absence of any specific trouble, so that it may be positively stated that it is in no wise dependent upon the presence of syphilis or any other specific systemic disorder, the patches of which are never raised above the surface of the surrounding tissue, the tissue affected always remaining on a level, so to speak, with the surrounding parts. There is no tendency in the leucoplakia patches proper, in a majority of cases, to develop soreness or tenderness. Syphilitic patches, even of the secondary variety, are almost invariably tender to touch, and, as stated, there is exuding from the margins of the patches a serous fluid, there also being more or less tendency to sloughing. In connection with the patches of leucoplakia proper there are none of these manifestations.

It is doubly important that we understand this disease for the reason that it sometimes results in a dangerous affliction to the patient. If neglected, if not properly attended to, the patches progress and are liable to verge into carcinoma. Many cases—I may say many—there are quite a number on record where carcinoma, cancer, has developed the mucous membrane of the mouth for years preceding being afflicted by the presence of these patches of leucoplakia. In this fact lies the greatest importance of our being able to recognize the affliction and at least to warn the patient of what may occur if neglected. Patients generally are apt to attach little importance to the presence of leucomatous patches, for they may continue for years without causing any special inconvenience.

The treatment of this affliction is not satisfactory in all cases. It has been quite conclusively proven that no form of systemic treatment does any special good, except in the variety which is connected with secondary syphilis. In leucoplakia proper the treatment, at best, can only be local. If taken when first appearing, or in the early stages of the trouble, it can be cured, in the majority of instances. One author advises the use of pure balsam of Peru, to be applied locally to the patches as often as one is able to see the patient. This should be retained in contact with the tissues for ten or fifteen minutes. He claims that he has by this form of treatment alone cured many cases. Another form of treatment, advised and used by some, is equal parts of tincture of aconite root and iodine, drying the patches and applying the mixture thoroughly every two or three days. This treatment must be continued for some time to effect a cure. Another form of treatment, advocated by a prominent practitioner, is simply tincture of myrrh. He claims that by the use of tincture of myrrh alone he has cured many cases.

As indicated above, all cases, even if they are taken in the first stages of the inflammation (for we may truly call it an inflammation; it is by most authors termed a chronic superficial inflammation of the mucous membrane), do not yield to treatment. Some of them are very obstinate and seem determined to progress in spite of anything that can be done. All forms of irritation should be thoroughly removed from the mouth, whether mechanical or chemical; the use of acids, acid mouth washes, anything of this nature, which will tend to produce local irritation of the soft parts, must be done away with, and especially is it important in the treatment of this affliction to do away with the use of tobacco, either smoking or chewing. If any of these forms of indulgence are permitted to continue we cannot hope for the best results in the treatment of leucoplakia.

Those cases that are obstinate, that do not yield to treatment, continue to develop until finally the surfaces of the sores become more or less abraded and develop tenderness; they begin to slough, and, as stated, cancer is likely to follow, which condition, no one will deny, is not at all desirable.

This affliction rarely ever occurs in the mouths of individuals under twenty years of age, i. e., leucoplakia proper; in fact, I do not know of the record of any case in the mouth of an individual under that age. It is likely to occur from this age up to sixty. If a person has become fifty-five or sixty years of age without the development of leucoplakia, it is likely he will never be troubled with the affliction, although there are a few cases on record where persons at the age of seventy have been afflicted with it. It is rarely ever seen in the mouths of women.

I speak thus briefly of this disease, that we may be constantly on our guard and remember, whenever we recognize it in the mouths of our patients, the importance of prompt treatment and what may result if treatment is neglected.

TWENTY-SIXTH LECTURE.

Etiology of Neuralgia or Nerve Cries.

From the earliest time down to the present, certain phases or symptoms of disease, the pathology of which has either been obscure or unknown, have been grouped under general terms, which have been constantly changed as time went by, and which, in themselves, have ever been in a great measure vague and uncertain. A few centuries ago all manifestations of disease which could not be accounted for by inspection, or the ordinary methods of reasoning, were accounted for by the varying conditions of the humors of the body. But this method of reasoning has had its day, and we now classify these disturbances as manifestations of a diathesis; e. g., the presence of nerve irritants, such as uric acid or toxalbumins and the like in the blood are made responsible for chronic rheumatism or gout; and again, the circulatory medium becomes impoverished and can no longer supply the nerves with the necessary nourishment, and they cry out for the needed pabulum, and we call this neuralgia. Lodor, speaking of this subject, says: "The longer I study this matter, the more I am inclined to believe that a healthy nerve in a healthy perineurilemma does not ache, or if it does so, the case is rare." I have studied, observed and recorded these conditions thoughtfully, accurately, and I must say I am quite ready to accept his statement as true. The term neuralgia is by no means as definite and limited in its scope as many others, and why not eliminate it very largely from our scientific vocabulary and confine it to the few rare cases where nerves ache for no apparent cause.

The sources of pain are almost innumerable, and with this introduction let us consider briefly some forms of pain not directly traceable to a definite cause. In this class the source of pain may be found in a nerve itself or in its immediate surroundings, so to speak, or irritating substances carried to the nerve through the circulatory fluids may be the cause of the pain. In the first class may be grouped the following: Chronic inflammatory processes, not classified as neuritis; old adhesions, which are the result of inflammatory products, these ofttimes being present after cessation of the inflammatory process; changes in the perineurilemma, resulting from chronic rheumatism and kindred ailments; pressure upon a nerve from cicatrices and new growths, which frequently occurs in syphilis, where periosteal nodes or inflammatory changes about canals cause pressure upon nerve trunks; reflex, or referred, pain, especially occurring about the fifth pair of nerves, of which more will be said later on; pains in the back and in the loins and in the back of the head, which may be referred to as fatigue pains; and hyperesthesia of various sets of nerves, under which would naturally come hysteria and neurasthenia.

We may arrange the diathetic causes under a separate class, as follows: The accumulation in the perineurilemma and sheath of the various acids accompanying gout; auto-toxins and poisons, as mercury, copper and lead; cholemia, malaria, diabetes, syphilis and anemia.

We may well make a third class of causes for pain which follow and result from conditions or nerves, as above outlined in the two classes, and may be arranged as follows: Changes which occur more or less frequently in the blood pressure, also in the atmospheric pressure, and changes which occur in the lymph constituents and lymph pressure as well. And yet, you will notice, with all this there is no mention of cries of nerves, which are directly connected with the ear, throat, nose or eye, or with any source of pain usually clearly defined and traceable to any definite and recognized local disease, such as diseased dental organs, of which more will be said later on.

Gray defines neuralgia as "functional disease of the sensory fibers of the peripheral nerves, and manifests itself by pain." As generally used, this definition covers the meaning of the term, but if one studies more closely the various cases of pain, not emanating from a specific organ, or positively diseased part, it will readily be seen that the neuralgia, *per se*, is limited to progressively narrower fields; and that, after careful investigation has been made, nearly all cases of pain are better classified under other heads than that of neuralgia.

If one would study this subject in a thorough, systematic manner, he must not lose sight of lymph stasis, of auto-nerve poisons and of the effect produced by inflammatory adhesions, and by the products of, and exudates remaining after inflammations, modifying or restricting the functioning of nerves thus hampered.

Let us now consider briefly the first cause of pain mentioned, viz.: The local condition of a nerve which has suffered from inflammation and the function of which has been more or less impaired as a result. It is quite patent that an individual who has once suffered with a severe attack of neuritis constitutes within himself rather a safe index as to barometric and hydrometric conditions. And if one remembers that after a nerve has suffered from a course of inflammation, resolution rarely ever takes place perfectly, the above statement is not hard to understand. Three unnatural conditions usually follow the subsidence of the inflammatory process: A development of connective tissue in the bed of the nerve, binding it down; a development of connective tissue in the neurilemma and perineurilemma, thickening and rendering less pliable the whole envelope of the nerve; and, third, and perhaps more important than the other two, a partial vaso-motor palsy and stasis in the intimate vessels of the nerve, consequent upon the general inelasticity. A nerve, under these circumstances, more or less thickened and possessing poor circulation, does not so readily accommodate itself to the varying swing of atmospheric pressure and moisture that it otherwise does. How well do we remember, from the study of atmospheric conditions, during our boyhood days, that a man of 150 pounds' weight is under a pressure of 30,000 pounds, or 15 pounds to the square inch—this under normal barometric conditions of our latitude. If this pressure is suddenly changed, especially if it is lessened, a normal, healthy, vaso-motor center responds immediately, increases its grip upon the muscles of the blood vessels, and the lungs, without delay, hastily throws off the excess of gas, which, under the pressure of one atmosphere, is caused to be retained in the fluids, but which pressure is now somewhat reduced. This is not the action of nerves, the function of which has been so sadly interfered with, as is the case of those mentioned above. Because of their impaired condition as to elasticity and vaso-motor control, they are subjected to undue pressure—pressure of blood and of gas—and the individual suffers acutely ofttimes before the storm breaks. Mills quotes from Mitchell and Catlin in his recent work on the nervous system and its diseases, and shows a diagram, which seems to establish a close relation between pain and barometric pressure and the temperature. He says a moving space of the greatest barometric depression occupies the center of the vast area of every moving storm, known as the storm center, and which the rain generally precedes by from 500 to 600 miles, round about which is a forerunning area of neuralgia.

I have seen, and no doubt you have, more than one individual suffer these pains in the region of the face—facial neuralgia—from these causes and under these circumstances.

Healthy nerves make but a physiological note of lymph stasis, and the daily fluctuations in size of the brain and various portions of the body. But these fluctuating changes in the peri-vascular spaces and the lymph-channels may, and frequently do, affect, more or less seriously, nerve trunks which are hampered by being bound down with products of old inflammations and with impaired vaso-motor control. There occurs an ebb and flow of lymph thrice daily and this, in connection with the diurnal ebb and flow, causes a change in the size of various parts of the body, which is only a physiological change. The theory is now generally accepted as fact that the circumference of a limb varies perceptibly during the twenty-four hours, and is smallest in the morning at the time of the lowest temperature, and is largest in the afternoon and evening, when the daily temperature is at its highest point. And in this fact do we find an explanation of the statement that "rheumatic and gouty people, whose vaso-constrictors are more feeble, and whose lymph-channels are especially prone to fill in the evening, experience difficulty in wearing articles of clothing in the evening which were comfortable in the morning." Does not the same character of reasoning explain why individuals suffer nocturnal pains occasioned by pulps of teeth that are no longer actively inflamed, but are surrounded by an area of lowered resistance, if not of actual infiltration. Until the lymph tide was recognized as a possible cause, the severe and somewhat mysterious ache present in Morton's metatarsalgia, which usually came on after sundown, and also after a full meal, was difficult of explanation.

The third division of causes for pain, viz., the various irritating substances in the blood, being first produced in the body by imperfect tissue metabolism, is receiving daily more and more attention as investigators are continually searching deeper into the unknown realm of digestion and assimilation outside the intestinal tract. However, sufficient has already been gained to make it plain that the presence of certain substances in the blood, that are inimical to healthy nerve life, do cause pain. It has long been known that those who suffer with gout and rheumatism are especially prone to neuralgia. This is also true of alcoholics, syphilitics and of those who suffer with intestinal fermentation. No one even attempts to deny the fact that these disoders are potent factors in causing dyscrasia of the blood. One common, exciting cause of polyneuritis is diabetes. However, it is also true that nerve cries, which cannot be ascribed to neuritis, are caused by it. Von Noorden states that the earliest sensory disturbances to be found in diabetes are paresthesia, abnormal sensations and hyperesthesia of varying degree and location, and pain and cramps. It is also true that these neuritic symptoms appear very early, and indeed are not infrequently the first symptoms of which the individual complains, the painful areas being usually located in the trigeminal and in the crural nerves. But cases have been known in which the pains from these bodily disorders have been reflected to, and manifested in, the fifth pair of nerves, and on receiving proper medical aid for the bodily ailments the individual has completely recovered.

Haig, in his last edition of "Uric Acid in Causation of Disease," mentions uric acid as the cause of nearly everything from "gout to anemia, chlorosis to melancholia," and also of neuritis or of nerve pain. The fact that facial pains, or odontalgia, is not caused by various diseased conditions of the dental organs alone was, years ago, recognized by Marshall, and the same author also observed that many individuals suffering with gout would have odontalgia after having indulged in a heavy meat and champagne dinner; and this, too, when it was impossible to discover any diseased condition in the dental organs. Pope, to my mind, justly terms a combination of alcohol, tobacco and a late dinner a "powerful trinity in the causation of neuralgia."

I fain would go on with this line of reasoning, but I trust enough has already been said to convince you, if any need convincing, that all pains of a neuralgic character manifested in various portions of the face by no means have their origin in diseased conditions of the dental organs. We must frequently look farther for the cause of facial neuralgias. If we would practice in this connection intelligently, advisedly, we must study these various conditions and ailments, and study them thoroughly in all their bearings.

I will now consider the subject as related strictly to dentistry, also briefly stating, as I understand them, the principal differential diagnostic points of dental neuralgias and those of more general constitutional origin.

The fact that the dental pulp does not possess the sense of touch, which is a localizing sense, renders it very difficult, in many cases, to locate the actual seat of dental neuralgias. The pulp, like other internal organs of the body, is not intended naturally to come in contact with foreign substances from without, and is thus not supplied by the human economy with the sense of touch.

Pain, from any diseased condition of the teeth, is liable to be manifested in any part of the face other than the immediate vicinity of the diseased tooth; in fact, it may be set down as a rule that it will be manifested at some point more or less remote from the tooth, the pulp of which is diseased, rather than being manifested in the tooth itself. This will ever remain a most important factor in practice in connection with the diagnosis of facial or dental neuralgias. This is also true of the pains of hyperemic or inflamed pulps.

The pains which are manifested in the facial nerves, or the fifth pair of nerves, result from a great variety of causes. Not always, by any means, as we have already learned, are they the result of diseased conditions of the pulps themselves. But as frequently, perhaps, they are the result of diseased conditions of other portions of the system, or of some portion of the nerve trunk itself. This is another fact, or condition, which is very important, and one which must be constantly borne in mind in the endeavor to locate the cause of facial neuralgias.

The pains which are manifested in facial neuralgias are more frequently in connection with the second and third branches of the fifth pair of nerves, but are not always confined to these branches. The first branch of this set of nerves is rather frequently found to be the seat of the pains. Whenever the pain is manifested in the first branch, it is usually of systemic or constitutional causes. These may be termed occult causes, which means those that cannot be seen, or hidden causes, as a diseased condition of a nerve trunk, or some adhesion binding it down in the process of recovery from an injury; while in connection with neuralgias arising from diseased conditions of pulps, the pains are almost invariably manifested in the second and third divisions. They may be in one or the other, or in both, and are nearly always confined to the same side of the face in which the diseased tooth occurs, but in rare instances may be manifested in the opposite side of the face; while the pains of neuralgias from occult causes, systemic or constitutional, may be manifested in any portion of these branches and on either side of the face.

Pains occasioned by dental neuralgias are by no means confined to the face. If of long standing, they frequently extend down the side of the neck, being manifested in various portions of the chest, and not infrequently in the arms. The ear, also, is a frequent location for the manifestation of dental neuralgic pains. These pains are not necessarily constant, and most frequently are not, they being of a paroxysmal character, the paroxysms being inaugurated after a hearty meal, or from taking cold and hot drinks, thus subjecting the teeth to severe thermal changes.

True dental neuralgias usually come on slowly, gradually, while in nearly all cases from systemic or constitutional causes the pains are brought on very suddenly. The pains from dental neuralgias are aggravated a great deal at night, more so than during the day, when the individual is on his feet and moving actively about. At night the individual assumes the recumbent position, and the pressure of the blood throughout the face and various other portions of the head excites the paroxysms of pain; while the pains in connection with systemic causes may be constant, during the day as well as the night, and especially is this true if the pains are being manifested in some part or other than the head. If the pains from constitutional causes are being manifested in the region of the head they, also, will be more severe, as a rule, when the individual assumes the recumbent position.

A difference of much importance in connection with the differential diagnosis of pains manifested from causes occult and those of dental neuralgias is this: Those of neuralgias from the former causes are, in most instances, manifested in the surface of the skin, the latter being exceedingly tender because of the diseased condition of the nerves, the slightest pressure upon its surface causing severe pain. In connection with neurálgias, which are purely dental, this is rarely ever true. The pains at various parts about the face or gums are seldom manifested in the surface, but are almost invariably deep-seated, being manifested deeply within the parts. Occasionally a tenderness will be manifested in the surface of the mucous membrane in dental neuralgia, especially opposite the inferior dental foramen, where the nerve passes out of the body of the bone, and also, occasionally, about the region of the infra-orbital foramen. But these manifestations are of rare occurrence.

Individuals of a neurasthenic diathesis are especially subject to neuralgias. Many are born, seemingly, with this diathesis—liability to diseased conditions of the nerves throughout the system. However, this condition may be acquired later on in life. Anemic individuals are especially liable to neuralgias, not only dental, but most any form of systemic origin. And those living in malarial districts are especially liable to neuralgias of various characters.

With this consideration of neuralgias in general, and these differential diagnostic points between general neuralgias and dental neuralgias, let us consider briefly some of the most common causes of dental neuralgias. And first, let us never lose sight of the fact that, at the best, the causes of facial neuralgias—the majority of which, perhaps, are dental—are not well understood; also that the number of cases of true neuralgia that develop from diseased dental organs is comparatively small, and that patients not infrequently suffer neuralgic pains for weeks and months, when one is unable to locate the cause, or to ascribe any reason for their continuance.

Inflamed pulps are a frequent source of continued, or recurrent, reflected pains, the nature and characteristics of which make it proper to refer to them as neuralgic, as the term is ordinarily used. Calcification of the pulp, in any of its various forms, frequently induces pains, which are as properly termed neuralgic. Another cause of reflected pains, referred to as neuralgic, is imperfect root-canal fillings. Not infrequently a small portion of the root-canals at their apices are not perfectly filled; moisture and other necessary elements accumulate and degenerate, gases form, in consequence pressure is exerted on the soft tissues in the apical spaces, the nerve filaments are thus disturbed and the result is reflected pains, ofttimes of a severe character—neuralgia, as we call it. Another cause of reflected pains—neuralgia—sometimes in its most aggravated form, is mechanical abrasion of the teeth. How often is observed a wasting, of especially the anterior teeth, by this process, nearly to the gum line. Cases of this character have come under my observation, in which it was necessary to devitalize the pulps of the anterior teeth of each jaw before a cessation of pain was effected. In such cases, where the pains are occasioned by diseased pulps, they will not always cease immediately upon devitalization. I have known the pains, in cases of long standing, to continue more or less severe for several days, gradually abating after a removal of the pulps. Not infrequently a lifting away from roots of teeth, of the peridental membrane, by the burrowing of pus or the formation of phagedenic pockets, also from the absorption of the alveolar plates of bone, or by spiculæ of bone remaining and constantly irritating the edges of the peridental membrane, severe pains—taking on all the characteristics of those of true neuralgias—have been known to result. Excementosis of the roots of teeth is not an infrequent cause of neuralgic pain, more or less severe. Malposition of the teeth, especially of the third molars, have been known to cause neuralgic pains of the most aggravated form. The occlusal surfaces of these teeth sometimes rest against the distal surfaces of the second molars, or the position of the teeth may be normal, the angle of the jaw being too short—as we refer to the condition—so that the parts about are severely crowded, the nerve trunks are thus subjected to constant irritation, resulting in severe pains.

TWENTY-SEVENTH LECTURE.

Care of Children's Teeth.

The proper care of children's teeth, not only the permanent teeth of young children, but especially the deciduous teeth, is a question of more importance than a great many dentists are in the habit of ascribing to it. The main purpose of the deciduous teeth is the mastication of food—whatever hard food the child is to take—until they are replaced with the permanent set, and the first of the temporary teeth are not replaced with the permanent ones until the child is five or six years of age, the incisors being the first. For appearances, or esthetic reasons, it is very necessary that the anterior teeth be preserved, if possible, until it is time for the permanent ones to replace them. It is doubly important that the molar teeth of the deciduous set be preserved until the permanent teeth are ready to take their places, not only important that the child may be able to properly masticate his food, but also to prevent irregularities in the eruption of the permanent teeth. This also applies with equal force to the anterior teeth. For, if the temporary teeth are extracted or lost before they should be, before the permanent ones have developed and are ready to take their places, the substance of the jaws is so soft, not being thoroughly calcified, perhaps, throughout a portion of its structure, that there will invariably be a contraction or other change, thus narrowing or otherwise altering the shape of the arch. As stated, when a temporary tooth is extracted the jawbone will contract; the space will be more or less closed, and often to a very great extent, so that when the permanent tooth erupts there is no space in the line of the arch for it; hence, it is crowded out of its proper position and forms an irregularity of the permanent teeth. This early premature extraction of the temporary teeth is a very prolific source of irregularities of the permanent teeth.

There is one thought in connection with the early extraction of the temporary teeth, however, which must not be overlooked, because the expression is so frequently heard that the early extraction of the temporary teeth hastens the eruption of the permanent teeth. This, in one sense, is true, but in the larger sense it is not true. Unless the permanent tooth has developed to such an extent that it is ready to occupy the place of the temporary tooth, the effect of the extraction of the temporary tooth will be just the opposite to that of hastening the eruption of the permanent one. It will cause a delay in the eruption of the permanent tooth, for if the roots of the deciduous teeth are not absorbed to a great extent their sockets will be filled in with bone tissue, so that it is necessary in the future that this bone structure be absorbed by the on-coming permanent tooth, and whenever this occurs the eruption of the permanent tooth is delayed, rather than hastened, because of the necessity of the resorption of the bone thus formed over it.

It is by no means an easy matter always to successfully treat deciduous teeth. The patients are young, they have not arrived at the age of life where they are capable of reasoning or understanding the necessity of such work and simply think, if they think anything, that they are being abused all the time that they are in the dental chair being hurt. And at the same time a great many children have not had the proper necessary training at home, so that when they come to have their teeth operated upon it makes it all the more difficult to control them or to work in anything like a satisfactory manner, so one has to work under the greatest disadvantages in dealing with these little ones. It is usually best to deal with little children gently, to rarely ever use harsh measures in working for them, or be cross with them. However, this is a difficult matter in all cases and occasionally the opposite treatment, to a certain extent, results in good, especially where the child is a trifle farther advanced in years, so that he has arrived at that stage where he can begin to reason and understand something of the necessity of this work. Another point in dealing with them is this: In the majority of cases one will get along a great deal better when their parents, the mother—who is usually the one to come with them—remains in the waiting room, leaving the child to the operator's care while the work is being done.

I have a great many little children as patients and there are comparatively very few with whom I desire or permit the mother to remain in the operating room while I am working. The children always look to the mother for sympathy, and the instant they are hurt the least bit they turn to her as the "cure-all," and expect her sympathy and her interference, and she, in the large majority of cases, as is natural, will at once begin to sympathize with them, which makes matters all the worse. Whenever these conditions confront me in my office I invariably request the parent to take a seat in the waiting room, and, if necessary, close the door and deal with the child myself.

Aching Pulps of Deciduous Teeth.

In caring for cases in which the cavities have not developed to a sufficient extent to make devitalization necessary, the treatment is practically the same as in connection with permanent teeth; the medicines used and the manner of their use is virtually the same; the sedative agents, those which will have a tendency to reduce the inflammatory condition, the pathological state of the soft tissues, should be used and should be sealed in, the decay previously being removed as well and as thoroughly as may be. It is rarely ever advisable, in working with the deciduous teeth, to attempt to adjust the rubber dam. A child so young cannot endure the rubber on his teeth for any length of time, so that absorbent cotton, bibulous paper, etc., should be used to keep the parts as dry as may be.

If a cavity develops in a deciduous tooth to a very great extent and the pulp has been aching for any length of time, it will almost always be necessary to devitalize. The thought is that medication for the purpose of allaying the diseased condition is rarely ever satisfactory in connection with such cases. When it becomes necessary to devitalize it is an important question as to what should be used for this purpose. In cases where the roots of the teeth are fully developed, where the foraminal openings are normal as to size, and when possible to have the little patient return in a comparatively short time, in my practice I seldom hesitate to use arsenic. The pulp-chambers and the pulp-canals of the roots of deciduous teeth are relatively large as compared with the permanent teeth; the foraminal openings are, in nearly all instances, relatively larger than they are in permanent teeth, so that in dealing with these cases one should satisfy himself that the roots are fully developed before deciding to use arsenic. Then a small quantity should be used, comparatively, and it should not be left in contact with the pulp tissue more than three or four or five or six hours, as the case may be; never twenty-four hours. Have the patient return the same day and remove it and make the next treatment in order. If these precautions are observed trouble will rarely ever result. Other agents which are used, where it is not advisable to use arsenic, or where it cannot be used successfully, are not very satisfactory. We have no agent other than arsenic that we can seal in the cavity in contact with the pulp that is safe to be left there twenty-four hours, or such a matter, that will positively destroy the pulp; it has to be done gradually and frequently by many applications of the agent. Carbolic acid is one of the agents which may be used for the gradual destruction of these pulps. Beechwood creasote is also used frequently, and after a time the agents will effect the destruction of the pulps of deciduous teeth, but, as stated, the process is slow. They have this virtue, however, that if the pulp at first is inclined to ache, they impart a soothing, sedative effect upon the organ, thus tending to reduce the pain.

Abscesses.

It is not always possible to successfully deal with abscesses in connection with deciduous teeth. If the roots of the teeth are not well absorbed, if there is danger of bone forming in the sockets covering over the permanent teeth which are imbedded in the substance of the jaw, the deciduous teeth in connection with which abscesses have developed should not be extracted until all efforts to cure the abscess have failed. If the roots of the deciduous teeth are half or even two-thirds absorbed so that there will not be much bone formation over the permanent teeth, and not much danger of contraction of the jaw and an irregular condition of the permanent teeth likely, extraction of the deciduous teeth thus afflicted is justifiable. Under such conditions I rarely ever temporize with them because it is not worth the while.

Treatment.

The treatment of these abscesses is in no essential different from the treatment of abscesses connected with the permanent teeth. The same remedies are indicated, with the exception that the milder agents should be used in dealing with little children. Such agents as carbolic acid should rarely ever be used, because of the danger of being unable to control all the conditions and thus confine the remedy to the diseased tract; the danger of it getting out on the soft parts and burning them and thus resulting in more or less destruction of the soft tissue. So use the milder agents and treat in the same manner as in connection with the permanent teeth. However, where there are no complications—and there rarely ever are—in connection with abscesses in deciduous teeth, they will yield more readily to treatment than many forms of abscesses connected with the permanent teeth. The cellular structure of the tissue is in an active condition and the healing process is carried on readily and rapidly, so that one or two thorough treatments through the diseased tract is usually sufficient.

Canal Fillings.

What shall we use in filling the roots of deciduous teeth when it is necessary to fill them? This is another question of more or less importance. And I will state that individually I have seldom used gutta-percha or gold or any of those materials which we use in the root-canals of permanent teeth, and it has seemed to me that this has been justified, for this reason: You must constantly bear in mind that the roots of deciduous teeth are to be absorbed, the permanent teeth are constantly pressing underneath them and they have to be gotten rid of to make room for the erupting permanent teeth. Gutta-percha will not be absorbed; it is not taken up and carried away by the lymphatic system. Neither is gold nor any other of the substances akin to these, and because of this fact it has seemed to me that it was not best to use these substances for filling root-canals of deciduous teeth. But in all probability I have had a wrong conception of this, and for this reason. Dr. Black told me the other day that in this connection he always uses gutta-percha—at first for some years he used gold for filling the root-canals of deciduous teeth; but latterly he has used gutta-percha and filled them exactly as he does the canals of permanent teeth, and has stated that in no instance has he observed any irritation or inflammation or otherwise bad results from the presence of this material or of gold in the root-canals of these teeth. He says that the substance of the root about these fillings will be absorbed just as readily as when the canals are filled with other materials, the pressure of the permanent teeth causing the absorption of the roots of the temporary teeth, and those root-canal fillings of gutta-percha or gold will be observed to be spread out about the crown of the permanent tooth, and the permanent tooth coming on in a perfectly normal condition. From this it would seem that there is no especial objection to the use of gutta-percha for the filling of root-canals of deciduous teeth. It has always been my habit, as I stated, to fill them with something else. It not being necessary that these teeth be retained, and cannot be retained for a very great length of time, at best, so that something that would not cause irritation, but which would keep the parts in a healthy condition for the time that the teeth are to be retained in their sockets, being, in my judgment, sufficient. I have used, perhaps, more than any other one substance, a paste of iodoform and oil of cloves, mixing to a thin creamy paste and packing the canal full of it. I have used in some instances paraffine wax, softened sufficiently so that after the canal is thoroughly dried and ready for the filling it can be packed solidly into the canal. But it seems that it does not matter much which of these methods is used in connection with this work; as stated, all that is necessary is something that will keep the teeth in a healthy condition until they are ready to be replaced by the permanent ones.

I do not know that it is necessary to say anything regarding the filling materials for the cavities in these teeth; you have had that, no doubt, from Prof. Black. It is rarely ever desirable, in my judgment, to use gold for filling cavities in deciduous teeth, and you will rarely ever find a patient or a parent who wants that done. In small cavities, where the child is able to bear the operation and the parent wants it, I see no objection to it. But as a rule the filling material will be cement or amalgam, something of a plastic nature; the oxy-phosphate cement, perhaps, more than any other one substance. Amalgam should be avoided in cavities in the anterior teeth because of the ill-appearance. Cement, even though it has to be replaced quite frequently, is as a rule better for these teeth. In the deciduous molars amalgam will be better, especially so if the cavities are on the occlusal surface where there is constant wear upon the filling. A mixture of cement and amalgam I have frequently used to good advantage. Take about equal parts of amalgam and cement before either has set and mix them thoroughly together and make the filling of it. This mixture has the advantage of the stickiness, so to speak, of the cement, causing it to adhere to the walls of the cavity, and the hardness, to a certain extent, of the amalgam. There is, in my judgment, no other filling material that can be used in these cases that will preserve the teeth as well as tinfoil properly inserted. This material is not suitable for the anterior teeth, as it turns black in the mouth.

First Permanent Molar.

A great many parents look upon the first permanent molar as a temporary tooth because it is erupted while the child is comparatively so young, and for the reason that they consider it a temporary tooth, and that it will in the future be replaced by another, they frequently neglect it, permitting it to decay, so that it has to be extracted. It should be your constant endeavor to impress upon the minds of your adult patients that these are permanent teeth, and not only permanent teeth, but are, in the main, the most important teeth in the mouth of the child to be retained throughout life, and that it is necessary that particular care be given them. These are the largest of the molars and the most important to be retained, but when they present with their crowns more or less destroyed, just what to do with them that the best interests of the patient may be served is frequently a perplexing problem. This is a fact, that when it becomes necessary to devitalize and fill the root-canals of these teeth, while the child is very young, they will not remain useful teeth for very many years. Even though the operation is successful, the root-canal filling is perfect and there is no trouble from that source, yet it is a clinical fact that these permanent teeth with canals filled so early in life fail in the course of a comparatively few years. There is something about their development, something about the condition of the bone and all the other parts connected with them, that does not withstand the stress of mastication as well as they do when the patient is older before the pulps are devitalized. Four or five or six years, at the most, may be considered as the extent of time to which these teeth will remain serviceable. So that unless there is some special reason why these teeth should be retained, it is well in a great many instances to extract them, when devitalization becomes necessary. If the crowns of these teeth are wasted from the time of eruption to twelve years of age it is undoubtedly best to extract them. If extracted thus early in life the second permanent molar and the third permanent molar will nearly always move forward bodily, thus occupying the space formerly occupied by the first molar, there being very little tipping of the second molar. Tipping of the second molar occurs when the first molar is extracted later in life, anywhere, we may say, from ten to fifteen or eighteen years of age. It is also a question, where it is deemed advisable to extract one first molar, whether or not it is well to extract the first permanent molar on the opposite side in the same jaw. My judgment is that it is best at this period of life to extract both, for the reason that if one only is removed the teeth of the entire arch will shift to the side from which the tooth was removed, and not infrequently they will thus move a distance equal in width to an incisor. Hence, when extraction is to be done, it should be done as early in life as possible, and if one is removed, as a rule the other molars will move forward and occupy the space in a more or less even and regular manner.

This thought may be worthy of consideration; it may be well, especially with older children, after having extracted one of the first permanent molars, to adjust some sort of an appliance—bands to the second molar and second bicuspid—with a bar extending across the space so as to hold them in their normal position and retain the normal width of the space in the jaw until the patient is old enough to have a piece of bridge work inserted. This applies to cases in which it is not advisable to extract the first permanent molar in the opposite side of the jaw.

It is indeed quite impossible to present a set of rules to be closely followed in dealing with the various diseases that present in connection with children's teeth. One must use and be guided largely by the various conditions that present in the individual cases.

TWENTY-EIGHTH LECTURE.

The Relative Toxicity of Cocaine and Eucaine.

(Copyrighted, 1899.)

Cocaine hydrochlorate is a white crystalline alkaloid obtained from the leaves of the *erythroxylon coca,* a small shrub of Peru and other western South American countries. Its extensive use as a local anesthetic is so familiar to all that repetition here is unnecessary. It is not my intention in this paper to especially refer to its anesthetic properties, only its toxic effects relatively with those of eucaine, as observed in actual practice, and as determined by original experimentation.

Eucaine is a colorless crystalline powder of German production, and was placed on the market some years ago as an anesthetic to be used in a similar manner to cocaine. It was soon observed that the first product, or that which is now called alpha eucaine, produced many undesirable and some very disagreeable effects, so much so that its use was soon largely discontinued. In February, 1897, Dr. Silex of Berlin brought forward a new substance, called eucaine "B," that it might be distinguished from the first, or eucaine "A." These substances are now termed—the first product alpha eucaine, and the second beta eucaine. The use of alpha eucaine has been almost entirely discontinued, and it is no longer furnished by the dealers unless especially designated in the order.

Beta eucaine is said to be chlorohydrate of benzoylvinyldiacetonalkamin.

Were the action of these drugs as anesthetics always unattended with disagreeable and, as is sometimes the case, alarming symptoms, both of local and systemic character, they would be to the dental and medical professions one of the greatest boons of the present century. Many minor surgical operations, both in general and dental practice, could, by the aid of these drugs, be performed with greater facility, and with equally good results, than can be performed without their use. Unfortunately cocaine is, in its action, one of the most inconstant and unreliable drugs in the whole pharmacopœia. It will always produce anesthesia, if properly used, and also frequently produces poisonous symptoms, ofttimes alarming. If a certain quantity of arsenic or morphia, or almost any other known poison be used under certain circumstances, the resulting symptoms are nearly always the same; we know what to expect. It is unfortunate that the same cannot be said of the action of cocaine. I have often seen the most alarming symptoms of systemic poisoning result from the use of a certain quantity of cocaine, while in other individuals a like amount under seemingly the same conditions produces no bad symptoms. There is no other drug in the whole realm of medicine in connection with the action of which individuals vary so much in point of susceptibility. I have seen all the stereotyped symptoms of systemic cocaine poisoning result from the use, in a pulp canal, of a small quantity of a 1 per cent solution, while again I have seen 20 minims of a 2 per cent solution injected into individuals, and this repeated as high as four times, without poisonous symptoms resulting, so varying is the susceptibility of individuals to the action of the drug.

I cannot pass on without calling your attention to the fact that I as firmly believe that cocaine produces, in some, local as well as systemic poioning, notwithstanding the fact that many disagree with this statement. I have seen, from the subcutaneous use of cocaine, for the extraction of one root of a tooth, three good teeth lost, with extensive destruction of the alveolar plates of bone, together with extensive sloughing of the soft parts, and all this in the absence of any systemic symptoms. Some, no doubt, will say this is the result of infection by an unclean syringe. But how is it to be proven that this is the case? The work has been done under the most careful antiseptic precautions. I have seen so many cases of local poisoning in varying degrees result from the use of this drug that I am forced to the belief that it possesses local toxic properties as well as systemic toxic properties.

Note: Some explain this by saying that edema is caused by the injection of a liquid that has a local ischemic action, driving the blood from the part and not permitting the circulation to become reinstated in that part; and it is true, ofttimes, that in using cocaine subcutaneously for minor surgical operations, incising the tissues, it has been observed that the edges of the wound do not reunite, the tissues remain more or less whitened, as if edema were present, and gangrene of the soft parts results.

As to eucaine "B" there is much to be said in its favor as compared with cocaine. During the past year I have frequently used it in practice for devitalizing pulps, for local applications, and by injection, and have as yet observed no evil effects of note. Eucaine, however, is not capable of producing the same degree of anesthesia under like circumstances as is cocaine. This has been proven beyond the possibility of a doubt by the experiments I have made. As this paper is to deal only with the toxic properties of these drugs, I will not here discuss their anesthetic properties.

Last year, while experimenting extensively with the esential oils, using guinea pigs largely, I did some work with cocaine and eucaine, enough to demonstrate that there was an interesting field in contrasting the two. Since then I have experimented extensively with these agents, using guinea pigs.

How completely is the statement that cocaine varies much in its action demonstrated and proven to be correct, by the following experiments: The first one serving to exhibit the poisonous propensities of the drug, and this, too, in the absence of any marked anesthetic effect. A pig, weight, 8½ ounces, into which was injected 20 minims of a 2 per cent solution of cocaine, which amount represents 2-5 of 1 grain, after the lapse of eight minutes showed some indications of anesthesia, but these were comparatively insignificant. For the next six minutes various symptoms of distress were exhibited, such as a general spasmodic jerky action of all the muscles of the body, accompanied with evidences of pain. At the end of fourteen minutes its hindlegs were partially paralyzed, and one minute later it fell on its side completely overcome. Its head was firmly drawn back, all the muscles of its body being rigid; this condition would, at short intervals, give way to a distressful spasmodic action, general in its scope, and thus these sets of symptoms continued to alternate for a period of five minutes. During these twenty minutes the animal was not anesthetized to any appreciable extent, responding vigorously to a prick of the needle at any portion of the body. The heart action was at first somewhat depressed, but soon recovered, and thereafter its contractions were strong and rapid, evidently being much stimulated. The respiratory organs, at first slightly stimulated, were very soon depressed, and remained so until recovery set in. After twenty minutes it began to recover and at the end of twenty-five minutes could stand on its feet; however, could not walk without falling. At the expiration of forty minutes recovery was far advanced. This experiment shows the toxic action of the drug with the absence of anesthetic effect, better than any other on my list. While the poisonous propensities of this drug are frequently manifested, they are usually accompanied with anesthesia.

The following experiment shows in just as interesting and decided a manner the anesthetic action of the drug to the exclusion of nearly all manifestations of poisonous symptoms. Weight of pig, 8½ ounces; 20 minims of a 2 per cent solution of cocaine were injected at 10:15½ p. m.; at 10:25 general anesthesia was quite marked, there being little response to the prick of a needle, and when placed on its back could hardly regain its feet. The heart action was somewhat depressed. At 10:27 it fell to its side, the heart action being now about normal; respiration somewhat shallow and quick. At 10:37½ it regained its feet and occasionally evinced a desire to run away, its heart action now being strong and rapid and respiration normal. At 10:46½ 10 minims more were injected, this making in all 3-5 of 1 grain. The side in which the second injection was made almost immediately became swollen, as if considerable edema was induced. This has been noted by others and forms the basis of the claim of some that local sloughing is only due to infection of the products of edema, which have infiltrated the tissues, liquefaction or pus formation taking place and sloughing finally resulting. This is no doubt true, ofttimes. Up to 10:56 the pig remained on its feet, and for the last five minutes preceding would walk about, prick up its ears, look up and chirp, and in various other ways gave evidence of enjoying a period of that intense beatitude and inner joyousness, while a succession of visions and phantasmagoria, most brilliant in color and form, trooped rapidly before its eyes—as related in Wood in connection with the experience of Montegazza, while under the influence of this drug. Occasionally it would make a sudden rush, as if impelled by a plenitude of physical power, such as also took possession of Montegazza at various times. At 10:56 symptoms of general anesthesia were quite marked, a condition of general relaxation rapidly developing. At 11 it became unconscious and sank to the table on its side. Immediately after the second injection the heart action was noticeably depressed, but quickly revived and became exaggerated over that of the normal. The respiratory apparatus was somewhat depressed most of the time. At 11:03 there occurred a slight general spasmodic action of all the muscles, its head being slightly drawn back, and was accompanied with a feeble cry, as if in slight pain. Action of the heart was strong and rapid; its breathing quick and shallow; true tetanus of various muscles was observed. This endured only an instant, all the muscles becoming perfectly relaxed as before. Thus the animal continued in a state of perfect general anesthesia. At 11:06 action of the heart became feeble and respiration scarcely noticeable. At 11:12½ the animal was apparently dead; respiration and the heart action both ceased. Thus it lay for 30 seconds; at 11:13 a faint gasp was observed, followed quickly by a second and third. The heart began to beat feebly, and in another two minutes, or at 11:15, the heart was beating regularly, but not so rapidly as normal; the respiratory apparatus was working regularly, but not strongly. Thus the animal remained in a perfect state of general anesthesia for 23 minutes, or until 11:38, when signs of recovery were observed. It was then placed in its box and in the morning was found to be as bright and lively as its mates.

The behavior of other pigs under the influence of cocaine has, in some instances, approached the behavior of this one, but no other has been so typical. This, in connection with the results of all my experiments in this particular, to my mind effectually settles the question of the inconstancy of the action of cocaine.

Let us now study the action of Beta Eucaine under similar circumstances.

Twenty minims of a 2 per cent solution of beta eucaine, or 2-5 of 1 grain, were injected into a pig of 8½ ounces weight. At the expiration of 13 minutes slight evidence of anesthesia—or perhaps better said, the action was that of a mild hypnotic, the animal appearing somewhat drowsy, at the same time all reflexes responding to any interference by way of pricking. The action of the heart and respiratory apparatus was slightly depressed. Three minutes later recovery commenced. and at the expiration of 20 minutes the effects of the drug had largely passed away. Two minutes later another 20 minims, or 4-5 of one grain, in all, were injected. Five minutes later slight evidence of nausea was observed; at nine minutes the hypnotic action was more marked and was accompanied with slight evidence of true anesthesia. Its hindparts were somewhat paralyzed, and the reflexes slightly blunted. The heart action and respiration were more depressed than at first. At 18 minutes it began to recover and at the expiration of 25 minutes, or 47 minutes from the time of the first injection, was able to walk about. One minute later, or 48 minutes from the time of the first injection, a third injection of 20 minims, making 1 1-5 grains in all, was made. Five minutes later nausea developed and the animal seemed much distressed thereby. The heart action and respiration being at first stimulated, soon became much depressed; after 10 minutes twitching of all muscles of the body, spasmodic in character, developed; this condition increased until, at the expiration of 18 minutes, the animal fell to the table completely exhausted. Its head was firmly drawn back, all the muscles being at high tension; rapid winking of the eyes continued, with gasping for breath and twitching of ears. For the next 20 minutes this condition continued, with violent tetanoid spasms of all muscles following one another in rapid succession, each spasm being accompanied with a mournful squealing, which seemed to indicate much distress and pain. At no time were the reflexes, either plantar or cremasteric, lost; neither was there much evidence of general anesthesia; indeed, the entire action seemed to be more that of a paralyzer than of an anesthetizer. The heart action and the respiratory apparatus were much depressed. At times the heart-beat was almost undiscernible, and the animal would gasp distressingly for breath. At the expiration of this 20 minutes signs of recovery developed, and at the expiration of 12 minutes more it could stand on its feet, but could not walk without toppling over. It was now very late, and the animal was placed in its box, and in the morning was found to be none the worse for its experience. This case is interesting in that it seems to prove conclusively that at least three times the quantity of beta eucaine is required to produce virtually the same degree of toxicity as is produced by cocaine. These results, or this action of the two drugs, as related in this experiment and the first one with cocaine, I regard as bearing directly on their toxic properties.

It has been stated that Legrand and Joanin, like Silex and Schmidt, have demonstrated that 1 1-5 grains of cocaine are necessary to cause the death of a guinea pig of 2 1-5 pounds weight, and thus 4⅝ grains of beta eucaine are necessary to cause the death of a pig of equal weight. I have been unable to secure pigs as heavy as this, the heaviest I have had weighing 26½ ounces. Taking their figures as a basis, and reckoning a fatal dose for a pig of less weight, in direct ratio therewith, it would require 5-6 of 1 grain of cocaine to cause the death of a pig weighing 24 ounces, and of beta eucaine 2 4-7 grains would be necessary. Let me say in this connection that this manner of determining a fatal dose for a pig of a given weight is not a safe one to follow in dealing with pigs of less than 24 to 25 ounces weight. My experiments seem to prove conclusively that the ratio of a fatal dose of these drugs decreases rapidly in proportion to the decrease in weight and age of the animal.

In my work 5-7 of 1 grain of cocaine proved the limit as a fatal dose for a pig of 24½ ounces weight. The symptoms manifested in this case were not in any essential particular different from those occasioned by a non-fatal toxic dose, which symptoms have already been described; except at times they were all exaggerated, and especially was this noticeable in connection with the heart. After the brief depression of this organ, which occurred at first, its action became greatly exaggerated, at times thumping violently, especially as the end drew near and the respiratory apparatus became more depressed. Death occurred at the expiration of 19 minutes by paralysis of the muscles of respiration—the heart continuing to beat feebly and irregularly for 30 seconds after breathing ceased.

This violent action of the heart above referred to seemed to be more an effort on the part of the animal economy to supply the needed oxygen to the system, through the medium of the circulation, during the period of respiratory depression, than it was the result of direct stimulation by the drug. The difference of susceptibilty of these animals to this drug is striking. In one instance ½ of 1 grain proved fatal to a female pig of 25½ ounces weight, while in another instance a male pig of 16½ ounces weight survived the effects of a like quantity. However, on the whole, I think the sex makes very little, if any, difference in the action of these drugs. The above fatal dose for a pig of the given weight has been determined after many experiments with pigs of different weights, and with different quantities of the drug. The same also is true in connection with beta and alpha eucaine.

Of beta eucaine 2 2-7 grains are necessary to cause the death of a pig of 24½ ounces weight. In this experiment death occurred in 32¾ minutes from the time of injection. The symptoms were not unlike those as already described in connection with the use of this agent, except, as in the case of fatality by cocaine, they were greatly exaggerated. At no time were evidences of anesthesia marked, nor were the reflexes entirely lost. The action of the heart and the respiratory apparatus was depressed after a brief period of stimulation at first. When violent spasms occurred, the heart action would be temporarily stimulated. Death occurred from paralysis of the muscles of respiration and of the heart, breathing and the heart action ceasing at the same time.

Alpha eucaine has proven to be virtually on a par with cocaine as to toxic properties. Five-sixths of 1 grain is the limit as to fatal action with pigs of 25¼ ounces weight. I injected this amount of alpha eucaine into a pig of this weight, and at the expiration of 7 minutes trembling of all its muscles occurred; at 9 minutes its head drooped with the nose to the table; at 11½ minutes the animal suddenly fell to its side and was seized with violent spasms; its heart action and respiration were temporarily increased, being much depressed very soon thereafter; nausea and some vomiting occurred; the drug also acted as a diuretic, renal discharge occurring quite freely; severe spasmodic contraction of all muscles followed one another in rapid succession, and were invariably accompanied with evidences of pain more or less severe. Death occurred at the expiration of 18 minutes, by paralysis of the muscles of respiration and of the heart, breathing and the heart action ceasing at the same time.

It has also been stated that cocaine cannot be sterilized by boiling, and that if subjected to a temperature of 176 degrees F. is transformed into ecgonin, a substance devoid of all analgesic power; also that boiling does not in any degree affect the efficiency of eucaine. I have demonstrated this statement regarding eucaine to be true, but if it be true regarding cocaine, my experiments in this connection are in error. According to them it is conclusively shown that boiling does not destroy the potency of this drug, but does modify it somewhat. I prepared a 2 per cent solution of cocaine and also of eucaine. These I subjected to a bath of boiling water for five minutes. These solutions were allowed to cool gradually, after which 20 minims of the cocaine solution were injected into a pig of 8½ ounces weight, with the following result: At the expiration of 7 minutes all its muscles were in a tremor and at 10 minutes control of the hind parts was lost; at 11 minutes it fell to the table completely overcome. The symptoms which followed were the same as in other cases, except that they were less violent. At the expiration of 30 minutes the animal had apparently recovered.

Into another pig of 8½ ounces weight were injected 20 minims of the boiled 2 per cent solution of beta eucaine. No symptoms of note followed this injection, with the exception that its hind parts were for a long time somewhat paralyzed. At the expiration of 22 minutes a second injection of 20 minims was made. The symptoms following this injection were virtually the same as those which followed the second injection of the other case as related above. At the expiration of 45 minutes after the second injection recovery was well advanced. A third injection of 20 minims was now made; the symptoms which followed were identical with, and somewhat intensified over, those of the other case related above. At the expiration of 46 minutes after the third injection the animal has nearly recovered.

By way of recapitulation, my experiments lead me to conclude as follows:

1. The action of cocaine is inconstant; one never knows whether the spmptoms occasioned by like quantities of the

drug, in animals or individuals, under like circumstances, will be similar or dissimilar.

2. The action of eucaine is constant. The symptoms occasioned by the use of like quantities in animals under like circumstances and so far as my experience has gone, in different individuals also, are the same.

3. The first action of cocaine on the heart is that of a depressant, and on the respiration it is that of a mild stimulant, the after effects being, on the heart, that of a decided stimulant, and on the respiration that of a decided depressant.

4. The first action of eucaine on both the heart and respiration is that of a stimulant, the after effects being that of a decided depressant.

5. Cocaine causes death in animals by paralyzing the muscles of the respiratory apparatus, the heart's action continuing in a feeble way for a brief period after breathing ceases.

6. Eucaine causes death in animals by paralyzing the muscles of the heart and of the respiratory apparatus, they ceasing to operate simultaneously.

7. Eucaine in toxic doses nearly always causes nausea and occasionally vomiting.

8. Cocaine is much less nauseating and scarcely ever causes vomiting.

9. Eucaine is decidedly a diuretic, causing renal discharge in a majority of instances in which a toxic dose is used.

10. Cocaine is not a diuretic to any appreciable extent, renal discharge having occurred in only one instance in connection with all my experiments.

11. The pupils of the eyes in nearly all cases of cocaine poisoning do not respond to light, and the eyeballs are more or less bulging from their sockets.

12. The pupils of the eyes in most cases of eucaine poisoning do respond feebly to light, and the eyeballs rarely ever bulge from their sockets.

13. The action of toxic doses of eucaine is more like that of a paralyzing, tetanoiding, convulsion-producing agent than it is like an anesthetizing one, the plantar and cremasteric reflexes nearly always responding.

14. Toxic doses of cocaine cause general anesthesia in connection with the other symptoms in the majority of cases.

15. True tetanus, of all striped muscles of the limbs, and Cheyne-Stokes' breathing nearly always occur with the use of cocaine, but seldom does either occur when eucaine is used.

16. Cocaine is at least three times more toxic than beta eucaine, and that alpha eucaine is nearly as toxic as cocaine.

17. Boiling does not destroy the efficacy of cocaine, but that it does modify it, and that boiling in no degree lessens the efficacy of eucaine.

The above deductions have been made only after many experiments in connection with each individual point. I have observed many interesting features in connection with the relative worth of these drugs as local anesthetics, but this paper is not to treat of this phase of the work. There is much experimental work yet to be done in this connection, the results of which I shall be pleased to present at some future meeting.

TWENTY-NINTH LECTURE.

Discolored Teeth.

It is true that the large majority of discolored teeth that present are in connection with cases of putrescent pulps or abscesses. A pulp may die, and if one is fortunate enough to secure the case for treatment before the pulp becomes putrescent, there will be little or no discoloration in the majority of instances; not enough to make it necessary to resort to the bleaching process. But if the pulp has become putrescent, if an abscess has formed, in most instances the crown of the tooth will be more or less discolored.

Before considering the methods of bleaching, let us study briefly the various conditions, chemical processes, etc., which will take place in these diseased parts, and which bring about discoloration of the teeth. It is desirable to a better understanding of the bleaching process to have a clear understanding of what is going on while the tooth is becoming discolored. It will be remembered that one product of the decomposition of organic matter is sulphureted hydrogen. In the decomposition of organic material sulphureted hydrogen is generated to a greater or less extent, and this material is formed within the pulp-chambers of teeth, while the pulp tissue is being decomposed through the influence of micro-organisms. This substance brought in contact with the hemoglobin of the blood which is oxygenated, a chemical reaction takes place, and a substance called sulpho-methemoglobin of reddish green color is the result, and it is no doubt due to the formation of this latter product, or substance, that the large majority of teeth are discolored. It is formed in the manner indicated and penetrates the dentinal tubules, thus causing discoloration of the tooth. There are other elements formed by the putrefactive process which have their influence in causing discoloration.

It may be well, before proceeding, to call attention to one occurrence which is rather frequently observed and which by many is not readily understood. A patient presents with a tooth containing a putrescent pulp or perhaps connected with which is a blind abscess. He happens in some day when the dentist is busy and cannot give the time that is necessary for a thorough treatment, and the dentist simply takes time to open into the pulp-chamber, so as to allow the pus, the gas, etc., to escape and relieve the pain. At this time the crown of the tooth is not much discolored. The patient is dismissed with the instruction to return the next day, or the second or third day. The patient returns and it is observed that the crown of the tooth in the meantime has become very much discolored, not infrequently black almost, within that short space of time. We wonder why that result. It is a well-known fact that when an excess of oxygen is present, in connection with the sulphureted hydrogen and the oxygenated hemoglobin of the blood, that the reaction is much more intense, and the formation of the coloring material proper, the sulpho-methemoglobin, occurs in much less time, and in larger quantity, than it does when an excess of oxygen is not present. In opening into the crown of that tooth the air has been permitted to pass freely into the pulp-chamber; thus an excess of oxygen gains entrance into the pulp-chamber, is brought in contact with these other elements therein, and the formation of the coloring material proper is augmented and hastened and readily penetrates the dentinal tubules, and the tooth thus becomes much discolored in a short time.

Causes Classified.

As to the causes of discoloration, they may in one sense be divided into two classes—*organic* and *inorganic*. Those termed organic include that cited above, and also discolorations occurring from the use especially of any of the essential oils, or other medicinal agents, some of which do cause the teeth to become discolored. It is a well-known fact that oil of cassia, if used to excess, or if its use is continued any length of time in the treatment of a tooth, will cause discoloration. So will oil of cinnamon. And in some instances, where beech-wood creosote has been used for some time, discoloration has occurred.

Inorganic Causes.

These cannot strictly be referred to as inorganic causes, for this reason—that in the formation of the various products, or the coloring elements, organic chemistry has played a part; but the action is brought about largely through the medium of inorganic substances; hence, we are in a measure justified in making these two distinctions. Under this division may be included, first, iron; discoloration from the presence of iron. Miller has said that of all the metals, iron, no doubt, is more largely disseminated throughout the system and plays one of the most important parts in the physiological economy of the system. A patient who has possibly an excess of iron in the blood, and the pulp of a tooth dies, and the red blood globules break up in the pulp-chamber, thus setting free the iron, this with sulphureted hydrogen forms sulphid of iron; it penetrates the dentinal tubules and thus causes discoloration, and discoloration of the crown of a tooth from this cause is one of the most difficult forms to correct that we are brought in contact with. Under this class may be included another element, which no doubt plays an important part sometimes in causing discoloration. A patient who is suffering from ptyalism—systemic poisoning by mercury—an excess of mercury in the system; a pulp becomes putrescent, or an alveolar abscess forms; the result is the formation of the sulphid of mercury, which will also assist in causing discoloration. There may be a slight excess of manganese in the system; if so, in connection with these processes there is formed the sulphid of manganese, which will also have its influence in causing discoloration. There is no doubt that discoloration of the crowns of teeth is ofttimes hastened or caused largely by the formation of the sulphid of silver and of tin; from the decomposition of particles of food, organic matter, and the formation of sulphureted hydrogen in connection with remnants of old amalgam fillings. Frequently an area of tooth structure is more or less discolored about an amalgam filling, even though the pulp of the tooth is alive; that is not an infrequent occurrence. If the pulp of a tooth, the latter having been filled with amalgam, is dead, not infrequently the crown is much discolored. In these cases discoloration is no doubt largely due to the formation of the sulphids of silver and tin.

These, in the main, constitute the manners in which teeth are discolored—the processes which are being carried on within the pulp-chamber while the teeth are becoming discolored.

Bleaching.

What is bleaching? The following is a good definition: Bleaching is the reaction between a substance possessing color and a substance which has the power to so affect the molecules of the coloring material as to cause them to lose their distinguishing characteristic, which is the color they possess.

There are some teeth so badly discolored and which have been discolored so long a time it is impossible to bleach them; no matter what process is resorted to, it is impossible to remove the coloring matter. It is not always possible to determine whether a tooth can be successfully bleached until the trial is made. Teeth discolored by the organic causes are much more favorable for bleaching than those belonging to the inorganic class. Those discolored with salts of iron and with iodine are very unfavorable.

Every effort should be made to bleach teeth that are strong enough to carry fillings, before deciding to replace the natural with artificial crowns.

There are conditions which it is necessary to observe in connection with the bleaching process: First, every tooth that is to be bleached should be treated, the treatment process completed, the diseased condition, whatever it may be, cured and the root-canal filled. As regards this point, the bleaching process must be the last operation in connection with the tooth. The material used as root-canal filling should be removed rootwise a distance of two or three lines beyond the gingivæ. If there is an old filling in any portion of the crown it must be carefully examined, for if there be any defect, no matter how slight, about the margins, so that it is possible for the saliva or discoloring agents generally to pass in and come in contact with the dentinal tubules, the tooth will invariably rediscolor, more or less, relatively, in a short time. A magnifying glass is necessary with which to examine these cases. Many times there are checks extending along the enamel at some portion of the crown, which are occasionally sufficient to permit the saliva, or coloring agents, to pass into the dentin. In such cases fillings should be inserted.

It is also useless to undertake to bleach teeth, the incisal edges or the occlusal surfaces of which are worn through the enamel, so that the ends of the dentinal tubules are exposed, unless these exposed surfaces are protected first by a perfect filling; for the same reason as in connection with the other case the tooth will rediscolor if this is not done. All these things are of the utmost importance by way of preparatory treatment to the process of bleaching, and if not carefully attended to the work will not remain permanent.

Bleaching Agents and Their Use.

There are various agents which are used for bleaching teeth. One which possibly is used more frequently in ordinary cases than any other one, is a liquid termed Labarraque's Solution of Chlorinated Soda. This preparation is put up in Germany. Of this agent chlorine is the active principle. Another agent which may be used, and is used by many to great advantage and with much success, is the Aluminum Chloride. This is a powder, and when fresh is nearly white, although it possesses a little color. Another agent which is used by a great many, especially during the past three or four years, is an etherial solution of pyrozone. For ordinary purposes the five per cent solution is sufficient. In severe cases, the twenty-five per cent solution may be used. Another agent which is frequently used with excellent results, and especially in the more severe forms of discoloration, those which do not as a rule yield readily to the ordinary agents, is oxalic acid. This is in the form of white crystals. Whenever used for bleaching, a saturated solution should be made in distilled water.

If the tooth is thick labio-lingually, so it is necessary for the bleaching agent to penetrate a thick body of dentin, it is good practice to remove a portion of the dentin underneath the labial or buccal plate of enamel, as the case may be. This removal of dentin must be conservatively done, and guided largely by the case in hand. Two objects are accomplished by this. That portion of the dentin most infiltrated with the discoloring material is removed, and the ends of the dentinal tubules are left in as fresh and open a condition as possible, which facilitates the absorption and penetration of the bleaching agent. The inner walls of the dentin, also the external surfaces of the crown—the enamel—should be thoroughly cleansed with fresh peroxid of hydrogen, thus removing all oily substances or other forms of debris.

When the solution of chlorinated soda is to be used, a pellet of cotton is saturated with it and passed into the cavity. If a small quantity of shaved alum is used in connection with the agent, the bleaching will be hastened. The alum assists in breaking up the compound, setting free those elements which act on the discolored material. So far as possible, this agent, as well as all other agents, should not be handled with steel instruments. There is no question that if the agents are handled with platinum or gold-pointed instruments, upon which they do not act, which they will not corrode, better results will be had, because these bleaching agents do, all of them, act more or less upon steel, and the result is that a portion of the compound formed, or the element which results from this action, is passed into the crown of the tooth in connection with the bleaching agent. This may seem a fine point, and no doubt is, ordinarily, yet it is one worthy of consideration. The alum, so far as possible, should not be shaved with a steel instrument, but should be pulverized in a glass mortar. Ordinary cases of discolored teeth will yield nicely to this treatment. One application may remain five minutes, on an average. If the case is not sufficiently bleached, remove that application and make another; and better results will be had from the second application of the agent if the cavity is thoroughly cleansed with fresh peroxid and dried. This process should be repeated until the desired results are produced.

In the use of Aluminum Chloride, which is a powder, as stated, the cavity should be packed with the powder and that in turn moistened with fresh peroxid of hydrogen, which I consider better for this purpose than the three per cent pyrozone. Let this remain five or ten minutes, and, if necessary, remove it, cleanse and dry the cavity and repeat the application, thus continuing until the desired result is secured.

The pyrozone solutions are to be used in a similar way. A pellet of cotton saturated with the five per cent etherial solution, if that is the one to be used, and passed into the cavity and left for a few minutes. It will be necessary to renew the application of this agent more frequently than the others, because the ether evaporates so quickly that the pellet of cotton becomes dry. I have thought in some cases that better results were produced and in less time by not only passing the solution into the cavity, but by keeping the enamel saturated with it also. Twenty-five per cent pyrozone is to be used in exactly the same manner.

In connection with the use of these agents for bleaching purposes, since cataphoresis has come to us, for the past few years the electric current (cataphoresis) has been used quite extensively by many to hasten the dissemination of the agent, throughout the tooth structure. Saturate a pellet of cotton with the bleaching agent, place it in the cavity and then apply the electric current just the same as in the cataphoric process for devitalizing the pulps of teeth or allaying sensitiveness of the dentin. The current assists in disseminating the agent throughout the tooth structure, and thus produces quicker results.

One of the agents which I mentioned is used by some, as they claim, to the exclusion of all others for the purpose of bleaching, and that is oxalic acid. This, as was stated, occurs in a nearly white powder or crystalline body, and when it is to be used for the purpose of bleaching, a saturated solution should be made in distilled water. This solution is passed to the cavity by means of a pellet of cotton and allowed to remain for five or ten minutes. If one application is not sufcient it should be repeated. A precaution necessary in the use of this agent, which is not necessary when others are used, is the thorough use of an alkaline solution. Care should always be exercised not to permit the oxalic acid solution to flow over the surface of the enamel to avoid deleterious action. If any of it should pass upon the surface of the enamel it should be washed thoroughly with an alkaline solution to render the acid inert. Any potent alkaline solution such as hydrate of ammonia or a solution of bicarbonate of soda may be used. The tooth and cavity should always be washed with an alkaline solution after the use of the oxalic acid solution is completed.

If desired results in bleaching are not produced at one sitting, the agents, excepting oxalic acid, may be sealed in the cavity with cement and allowed to remain for a day or two. Frequently this treatment results in much benefit. It is necessary, when thus leaving the agent in the cavity, that the latter should be sealed tightly, and this is not always an easy matter. But the excess of the liquid must be removed, and the enamel margins dried as thoroughly as may be, and the cavity, as stated, sealed with cement.

Bleaching Agents Classified.

As to their manner of action, these bleaching agents may be divided into two classes, viz., oxidizers and reducers. Oxidizers include the oxygen and chlorin compounds and produce results by oxidizing, or abstracting, the hydrogen from the coloring matter. Oxalic acid is a reducer and bleaches by an action the opposite of that of the oxidizers, or by abstracting the oxygen from the coloring matter.

Care of Cavity Previous to Filling.

The dentin throughout the cavity, in the pulp-chamber and root-canal, should be thoroughly dried, and, as a rule, should be painted with a varnish, such as copal ether, that will dry quickly, leaving a hard, impervious film over the exposed ends of the dentinal tubules, to prevent the passage into them of foreign material in the future. The varnish should be very thin, and applied with a fine camel's hair brush or a small pellet of cotton with the pliers. Whenever desirable, especially in the anterior teeth, in which the labial wall is thin, and the dark color of the filling material is liable to be reflected through, it should be lined with cement, oxy-phosphate of zinc, and the powder which is used for this purpose should be as nearly white as possible. Not infrequently I have used a small piece of plain white writing paper underneath the labial plate of enamel to prevent the reflection of the dark color. After painting with copal ether varnish, a piece of paper is cut to fit, and before the varnish is thoroughly dried is passed into the cavity underneath the labial plate of enamel and pressed evenly all over the surface, so that it is in close contact at every point, and then the lining of cement is placed. This I have found useful in some cases. The permanent filling should always be made immediately after the bleaching process is completed and the cavity lined ready for it.

It may not be out of place to state that the agents used for bleaching should be fresh, in order to insure good results. Labarraque's Solution of Chlorinated Soda loses its potency very quickly if uncorked for a time or left exposed to heat or light. The solution should always be tightly corked in a glass-stoppered bottle, and should never be left open any longer than necessary. The same may be said of Aluminum Chloride. This also must be fresh to insure good results. The powder should be kept in a tightly stoppered glass bottle, and only the quantity necessary to be used at the time taken out. These statements apply as well to the pyrozone solutions and the oxalic acid.

THIRTIETH LECTURE.

Abrasion of the Teeth.

We mean by abrasion of the teeth a wasting of the tooth's structure on the occlusal surfaces of bicuspids and molars and the incisal edges of the anterior teeth. This trouble occurs especially in individuals who possess a mal-occlusion of the teeth. The cusps of the upper teeth do not close properly in the sulci of the lower teeth, and vice versa, but occasionally, as we see them, the cusps of the teeth of each arch occluding one upon the other, and in the process of mastication the cusps are worn away. In a natural normal occlusion, where the cusps of one set close as they should into the sulci of the opposite teeth, there is naturally more or less wearing or wasting of the enamel. We may term this condition the formation of facets, or the forming of small faces on the surfaces of the enamel, and these almost invariably form on the sides of the cusps, not upon the ends of the cusps proper, and as these facets develop they simply serve to cause a more nearly perfect occlusion of the teeth, rather than developing a mal-occlusion or aggravating the condition as it first exists.

This—abrasion—is a condition of things of much more importance than the profession, generally, is in the habit of ascribing to it. As a rule, a case of abrasion being observed, no special attention or thought given it; it is passed by simply as a natural condition of things being brought about by the natural waste of the teeth through attrition of food. Whenever this difficulty is observed, in the mouths of young people especially, it should be given careful attention, in order to prevent severe or extensive destruction of the teeth in future years. And almost invariably when it is observed in the mouths of young people there will be, as stated, a mal-occlusion of the teeth—the cusps of the teeth of one arch grinding directly upon the cusps of the teeth of the other arch. Nothing has been done, to any extent, by the dental profession in the direction of correcting this difficulty when first observed, until, we may say, the last few years. Within the last few years I have seen many cases where an attempt has been made on the part of operators to correct the occlusion of the teeth by way of building artificial cusps of gold at the most desirable points, so that they will fit normally into the sulci of the opposing teeth and thus prevent the further destruction of the natural cusps. This has been done, and successfully done, in a number of instances.

The bicuspids and molars perhaps suffer most from this form of trouble. Not infrequently, however, the upper anterior teeth, especially the incisors, are wasted to a great extent by abrasion, especially the lingual surfaces; the tooth structure —the lingual plate of enamel and the dentin—will be worn to such an extent that the labial plate of enamel, approaching the incisal edge, is all that is left. And as this wearing and wasting of the dentin progresses, the enamel margins begin to chip and break away, which leaves the teeth in an unsightly, defective condition. Especially in bicuspids and molars, after the enamel has been worn through and the dentin exposed cups will form in the latter tissue, occurring simply because the structure of the dentin is so much softer than the enamel that by the friction of mastication it is worn out more rapidly. The only treatment for these cases is the protection of the surfaces—prevention of further waste by the placing of proper fillings or crowns, or whatever is indicated according to the special case in hand. This condition, if neglected, may progress to such an extent that two-thirds, or even more, of the crowns are wasted, not only the bicuspids and molars, but the incisors and cuspids as well. In extreme cases I have seen the crowns of teeth wasted even with the gum line.

There is a decided tendency manifested on the part of some individuals to continually rub the teeth—commonly called gritting. This occurs in individuals usually suffering from some form of nervous ailment. Frequently this class of individuals will unconsciously grit their teeth at night while sleeping, thus wearing them to a great extent. There is not much, by way of systemic treatment, that is beneficial in these cases. An articulating bite of soft vulcanized rubber, to be worn at night, will be found serviceable. It should be so constructed that the teeth of the upper and lower jaws will close into it perfectly on either side, also that the teeth of the two arches will be held from one-sixteenth to one-eighth of an inch apart.

Erosion of the Teeth.

Another form of wasting of the teeth that occurs rather frequently is that called *erosion*. This is evidently a chemical process, but the real cause is unknown to the profession. This destructive process probably attacks most frequently the labial surfaces of the upper anterior teeth. It may begin at any point on the labial surface next to the gum, forming a V-shaped space, the surfaces of which will be as smooth as if they had been planed or cut out with a sharp file, there being nothing of a roughened appearance. This may progress and include the entire labial surfaces of these teeth, or it may occur on these surfaces, the marginal outlines of which are oval, forming a saucer-like excavation in the structure of the tooth. It may occur on these surfaces in the form of a half moon. It may begin on the proximal surfaces of the teeth near the gum line and cut through the entire thickness of the proximal surface toward the pulp-chamber, forming a V-shaped space, the characteristics of the surfaces left after the wasting process being the same as the others, smooth and hard. The process of wasting may begin on a proximal surface and extend to and include the incisal edge of the anterior teeth, so that the appearance will be that which would be left if a file had been used or a corundum stone or a disc, beginning at the incisal edge and cutting toward the gum line, as if a cavity had been prepared for a step filling, the surface being left as in the other case, perfectly smooth and flat. Not infrequently the trouble has been seen to begin between two of the teeth near the gum line and working through from the labial to the lingual surface, a round or half round space being cut out of each tooth, exactly opposite one from the other, as if a small round file had been passed between the teeth, cutting equally from the surface of each. And in this form of erosion the wasting process has been observed to progress so far that the teeth were nearly cut in two by it. This is not by any means confined to the upper anterior teeth. The same conditions may occur on the lower anterior teeth. It frequently attacks the bicuspids and less frequently the molars. Whenever the bicuspid teeth are involved it is nearly always the buccal surfaces that suffer; there are comparatively few cases where the wasting process has attacked their proximal surfaces.

As stated, of the cause of this trouble we know almost nothing. Many theories have been advanced, some claiming constitutional disorders being exclusively responsible; others that the mucous membrane of the lips or cheeks that comes in contact with the surface of the tooth, being in a pathologic state, exudes an acid mucus which attacks and acts upon the tooth structure. Both of these theories have been contradicted by others.

The only cure for the trouble is filling, whenever it becomes necessary. In preparing these cases for filling the margins must be extended a great deal in order to remove all affected tissue.

There are some cases on record where this process has progressed to a great extent and all of a sudden has ceased, a spontaneous cessation of the process; this, however, rarely occurs.

Dr. Black, a number of years ago, made an experiment along this wise with a view of determining, if possible, the cause of erosion, or, of determining some sort of action on the teeth that would cause similar results as observed in connection with this process. His experiment was as follows: A very dilute form of acid, one part of acid to about four or five hundred parts of water, was placed in a glass jar. A glass pedal was so arranged in the jar that it could be revolved and thus keep the liquid in motion. Teeth were suspended in the fluid and the liquid set in motion. In the course of a few days the cusps began to waste in a manner similar to the condition observed in the mouth, and in a few days more they had entirely disappeared and little cup formations began to appear where the dentin was exposed, and along the necks of the teeth, about where the gum line would be, a little furrow began to develop and continued until it extended about two-thirds the circumference of the tooth, also nearly to the pulp-chamber. The process resembled nearly in every particular that which is observed in the mouth; the surfaces of the teeth were left perfectly smooth and hard. A stronger per cent solution of acid was used, with the result of a general softening of the tooth structure. But Dr. Black was unable to apply this experiment definitely as a cause of erosion, or to make very much out of it.

Not infrequently the surfaces of the teeth thus exposed by this process—and not only this, but by the process of abrasion

—develop extreme sensitiveness, both to instrumentation and to thermal changes. It may be said this is always the case, in teeth containing live pulps, unless a deposit of "secondary" dentin has occurred in the pulp chamber, thus obliterating the layer of odontoblastic cells and destroying the power of the fibrils of Tomes to transmit sensation. But secondary dentin is not formed in connection with all cases of abrasion or erosion; we may say that its formation constitutes the exceptional cases.

Amputation of the Roots of Teeth.

There are cases in which roots of certain teeth have lost their sockets through some disease, and the majority of these will either be in connection with alveolar abscess or phagedenic pericementitis, the attachment of the soft parts to the root of the tooth being destroyed often throughout its entire length. An abscess develops and effects a large excavation of the parts in the apical space, and especially in cases of the chronic form, where it seems impossible to cure the diseased tract by ordinary medication; yet, there is no special trouble in the other roots of the tooth; they yield nicely to treatment and if filled no trouble results. In certain cases the root which is thus diseased may be amputated, and the other roots will support the crown for years, ofttimes thus avoiding extraction and bridge work or plates.

The cases most favorable for this class of work are the first and second molars, especially of the upper jaw. When the lingual root is thus diseased it may be amputated and removed, and the two buccal roots, especially if they are divergent one from the other, will serve to support the crown better than if they are nearly parallel.

Whenever it seems advisable thus to amputate a root, the root-canal should first be filled with gold foil, as a rule; something that is perfectly hard and unyielding; not with gutta-percha, for the same reason mentioned in the amputation of the apices of the roots of teeth, for in cutting them off one is liable to disturb a portion of the filling material. Then a long fissure-burr may be used in most cases to best advantage. The root is amputated close to the bifurcation and removed from the socket. After the root is removed the surfaces should be smoothed as nicely as possible. It is seldom advisable thus to amputate one of the buccal roots of these teeth, although I know of cases where a buccal root has been thus removed, and the tooth has remained supported by the other buccal root and the lingual root. But in most cases where it is advisable to do this the diseased condition will be in connection with the lingual root. When this operation is indicated in connection with the lower first molar it will usually be the distal root, and in removing the root it should be cut close to the bifurcation, so as to leave as much space as possible between the gums and that portion of the tooth to facilitate cleansing in the future.

Excementosis.

Excementosis is an enlargement or an extra growth of the cementum at any portion of the root. Perhaps in the majority of instances the enlargement occurs at the region of the apex. It may occur upon any root of any tooth. There is very little, however, that can be said upon this subject. As to the cause of excementosis—it is undoubtedly the result of some form of irritation transmitted through the fibrils of Tomes to the pulp, the irritation being conveyed to other portions of the root, which excites an overactivity of the cementoblasts, and the result is an extra growth of the cementum. On the other hand, an overirritation of the root in this way, instead of causing an enlargement of the cemental tissue, may cause resorption of the same. So that excementosis is probably the result of a low form of irritation, from whatever cause, to the part; while, when resorption takes place, where there is no serumal deposit, no abscess, no necrosed or carious bone, it is usually the result of an overirritation, from whatever cause, of the parts. As to the diagnosis of this difficulty, nothing definite can be said. Excementosis was named as one cause of neuralgia. Pained occasioned thereby is frequently severe. Extraction is the proper treatment.

Prescription Writing.

It is my purpose to consider only the principles connected with prescription writing and the meaning of the various characters or symbols employed. It is not presumed that any of you in the practice of dentistry will engage extensively in prescription writing, although occasionally you will find it convenient to know how to write at least a simple prescription.

In the first place, as to the naming of drugs or the medicinal agents to be used in the prescription, where there is to be a mixture of agents, the one which is to be depended upon principally for service in the diseased condition, should be written first, the other agents of minor importance following. It does not make any especial difference as to the order of the minor agents, except in the quantity to be used. It is always well, where there are several to be named, to name following the principal agent the one which is to be used in largest quantity, and so on down the list.

The names of these drugs in prescription writing should be in Latin, and the genitive case endings of the words should be used. This, however, is not always adhered to.

As to the form of a prescription. After the date, the character or symbol ℞ should be placed at the upper left corner. Following that the name of the agent, the therapeutic action of which is to be the principal one.

Following is the meaning of the characters used:

℥	Ounce.	One	j
ʒ	Drachm.	Two	ij
℈	Scruple.	Three	iij
gr.	Grain.	Four	iiij or iv
m.	Minim.	Five	v
gtt.	Drop.	Six	vi
O.	Pint.	Seven	vii
āā.	Of each.	Eight	viii
fl.	Fluid.	Nine	ix
		Ten	x &c, &c
		One-half	ss

If, in writing a prescription, there are two or more agents, an equal quantity of which is to be used, instead of using, after the name of each agent, the proper character indicating the quantity, use no character excepting after the name of the last agent, there place the character representing the amount of each of the several agents to be used. Place the character āā immediately after the last named agent.

If it is desired to add water or alcohol or some other liquid enough to make a certain quantity, use the expression "qs.·ad.," which means add in sufficient quantity, etc. The character "sig." is placed at the bottom of the prescription to indicate the directions for taking.

One thing more that must always be looked to in compounding medicines is not to use agents one of which will antagonize the other, or agents which are incompatible.

Cataphoresis.

A few years ago cataphoresis occupied the attention of the dental profession for a number of months. It is by no means a new discovery. The same principles had been used years ago, and had been forgotten, we might say, for a long time. It is simply a revival of this old principle as we have it to-day, with the perfection of appliances and manner of using, etc., which have been brought about by the recent agitation of the subject. Cataphoresis simply consists of the use of the electric current for the purpose of causing the dissemination throughout the part of medicinal agents. Whether cataphoresis is a good expression for this process or not, is an open question; some say it is and some say it is not; some prefer the expression electrolysis, but that is of minor importance.

I shall not here attempt a detailed account of this process. There are certain things in the use of cataphoresis which have been learned by experience, that it is well to remember, and one is the use of the street current should be avoided in all cases; it is so difficult to know just what part of the current coming from the dynamos one is using in the negative and what in the positive, that it is a decidedly unsafe form of electricity to use for this purpose. There has been all sorts of difficulty occasioned by the use of the street current in cataphoresis, and I have seen any number of cases where the tissues were inflamed, destroyed, caused to slough, teeth loosened and in some instances lost by this process. The form of electricity which I like better than any other, and which is perfectly safe, is the dry cell batteries. There are none of the dangers connected with the use of the current from the dry cell batteries that arise with the use of the street current.

There are a number of cataphoric appliances on the market, and the majority of them, no doubt, are good, if one is accustomed to use them and knows how to use them.

By way of preparing the case for cataphoresis, it is absolutely essential that the cavity be positively isolated, that it be protected about all its margins, especially the cervical margin, so there can be no leak of the cocain solution or of the current, for good results will not be produced if there is a leak of the current. The rubber dam should be so adjusted that there is positively no moisture passing in about the neck of the tooth or the adjacent teeth. In proximate cavities in the bicuspids and molars it is always well to build an artificial wall, preferably of cement, over the cervical margin and let the cement extend against the proximating tooth half or two-thirds the way to the occlusal surface. After this has hardened, virtually a well-shaped cavity is the result, and there can be no leakage of the cocain solution or of the electric current. In using this process I always make a fresh solution of cocain for each individual case. I make a saturated solution of cocain hydrochlorate in sterilized water, moisten a small pellet of cotton with this and pass it into the cavity; then the positive electrode is passed into that, with the negative applied to the hand or some other portion of the body, and the current turned on.

If all these preliminary steps leading up to the use of cataphoresis are carefully observed, in those cases in which results are to be had in any degree, they will, in my judgment, be manifest in anywhere from five to ten minutes, just as well as in thirty or forty minutes. The idea is generally expressed that cataphoresis is of little value to us because of the large amount of time that it takes up. Where results are to be had at all, the whole secret, in my judgment and in my experience, lies in the preparation of the preliminary steps leading up to its use. I have in mind a number of cases in which there was an exposure of the pulp to begin with, and no inflammation present, where after five minutes' actual contact the pulp has been removed thoroughly and without pain. In other cases the same result has been accomplished in ten minutes; while in some instances I have spent half to three-quarters of an hour, and even a whole hour, without results. The experience of others is the same along this line. So that cataphoresis is by no means universally successful, even though all the care possible be exercised in preparing the case for its use.

The cases which are most favorable for the use of cataphoresis are to be found in young people. It works more readily and effectually in the teeth of young individuals. This is the universal experience. In connection with inflamed or hyperemic pulps little benefit is had from the use of this process. When cataphoresis is applied to pulps in this condition they are further aggravated and the pain intensified. It may be said in a general way that no set of rules governing the use or the action of cataphoresis can be given. It must be tried in each individual case before one can tell whether it will be successful or not.

One point of considerable interest is this—immediate root-canal filling should seldom be resorted to, after removal of pulps by this process. There is always hemorrhage following the removal of the pulp, and in some cases, relatively, a large amount. After sealing an antiseptic dressing in the canal, to remain a few days previous to filling, frequently much pain and tenderness develop. On opening into the canals of these cases blood is nearly always found to be present. The pain is, in my judgment, occasioned largely by what might be termed internal hemorrhage, an accumulation of blood in the apical space and consequent pressure upon the surrounding soft parts, especially the nerve fibrils. Hence the necessity of permitting these cases to rest a few days till the injured parts heal.

Systemic Treatment.

There is so much that can be said on this subject, so much that is useful to us as practicing dentists, and there is so much we might resort to that is unimportant that it shall be my endeavor to state nothing in this connection except what can be relied upon.

There are four fundamental principles to be observed in connection with all successful, scientific systemic treatment, no matter what part of the healing art one is engaged in.

1. The condition of the particular part of the system which is diseased, and which you are called upon to treat.
2. The condition of the circulation of the blood.
3. The condition of the nervous system.
4. The condition of the alimentary tract.

Dentists will be called upon to deal more especially with individual parts that are diseased, so that we will not be called upon to consider the condition of the other three principles, the circulation, the alimentary tract and the nervous system, nearly so much as simply the local part that is diseased. However, there are certain condition in connection with certain diseases where a reasonable amount of knowledge as to the conditions and requirements of these other three principles is exceedingly useful to us, and I will endeavor to present the cardinal principles or indications in connection with certain diseases that we will be called upon to treat.

First, I will consider systemic treatment as a means of preventing unnecessary suffering during dental operations. And more especially under this head in connection with patients where pain is not a factor to be considered. Patients sometimes present themselves in a very highly nervous, frightened condition, and especially is this the case in connection with individuals who are naturally of a nervous temperament. They make an appointment with their dentist, they go home, and during the time which elapses until the appointment is due they are thinking of what a terrible time they will have when they get into the dental chair, and as a consequence they are wrought up to the very highest nervous tension possible and frightened, and they come to us in this condition. The important question is, what can be done to overcome, in a measure at least, the condition of the patient so as to avoid, if possible, systemic medication? It should be the endeavor always to quiet such individuals and to restore them to their normal mental equilibrium by the use of local means. If one can accomplish the desired result in this way it is much better to do so than to resort to the use of drugs. Also the manner in which we meet our patients under these conditions, and the surroundings in the office, will have a great effect upon them. It is my judgment that in the majority of cases, if our own persons present a neat, cleanly appearance, everything about the office is clean and tidy, it will have a decided effect for good upon such individuals. On the other hand, if our offices are untidy, and ourselves not cleanly kept, the effect is just the opposite on the patient. There should never be an undue display of instruments, tools or office fixtures in the operating room. All these things should be kept, as far as possible, out of sight. I know that seeing a whole lot of instruments, appliances, etc., has an effect upon such individuals decidedly for the worse. The display of kindness, gentleness and manliness will go a long way toward reassuring such individuals. Failing in this, the next thing to do is to administer a proper nerve sedative-hypnotic, some drug that will have a quieting, soothing effect upon the nervous system of the individual. In these particular cases there is no pain to contend with, the patients are not suffering physical pain, it is simply a nervous condition, a mental anguish, brought on almost exclusively through dread of the operation, so that narcotics are not indicated, simply a mild, sedative-hypnotic. There are many agents that I might name. In such cases as these I have found nothing better than trionol. This drug occurs in shining crystals, is soluble in 1 to 300 parts of water at ordinary temperature. Its effects upon the system are perfectly safe, and, unlike most other drugs in this class, it leaves, as a rule, no bad after effects. Its action is prompt and efficient; the system does not become habituated to its use. This drug should be administered in doses anywhere from grains 5 to 30, fifteen or twenty minutes before beginning the operation. Another drug which may be mentioned under this particular head is sulphonol. It also acts very nicely, but the other is preferred in my practice. Sulphonol seems to produce best effects when used in single large doses of from grains 10 to 15. Our object, of course, in administering a hypnotic is not to put the patient to sleep; that should not be done, simply a mild agent which acts along these lines for the purpose of quieting the disturbed nervous condition of the patient. I have, in some cases, used muriate of ammonia, seemingly with excellent results. As a nervine in these cases this drug is not to be administered internally, but should be burned in the room, the patient thus inhaling the fumes.

In this condition of nervous excitement, when there is physical pain being borne by the patient, something aside from the drugs recommended is indicated. Drugs which also possess the properties of those named above, and more; those which have the power to allay pain are indicated. Narcotics, such as lactophenin, codeine, morphine, chloral and bromide of potassium. These drugs, when something of their action on the nervous system is understood, are safe to use, and any of them, under certain conditions, act very readily, and will assist much in dealing with such patients.

Systemic treatment as an aid to recovery from diseased conditions of the dental organs. What has been considered so far is simply for the purpose of returning the patient to a normal condition, so far as nervous excitability is concerned.

We will begin with the simplest form of trouble under this division.

First. Threatened formation of abscess. What treatment may be administered that will materially assist in preventing the formation, the further formation, we might say, of a threatened alveolar abscess? This may be divided into two classes, local and systemic.

LOCAL TREATMENT: The pulp chamber of the tooth must be opened, the debris from the root-canals removed and the opening effected through the foramen, so that the gases, etc., present and constantly generating may escape. The placing of some sedative antiseptic in the root-canal, and in the severest cases the cavity should not be tightly sealed for the first day or two. In connection with cases of this kind there is frequently severe pain, and even after one has successfully opened through the apical space the pain will continue for considerable time. Further treatment, which is in a way systemic, but may more properly be called local, is applying something to the soft parts about the tooth. The gums and peridental membrane are inflamed, the tooth is tender to pressure. These conditions occasion much pain. Hot carbolized water, applied to the parts with a syringe for fifteen or twenty minutes, will assist materially in controlling these conditions.

SYSTEMIC TREATMENT: If the above is not sufficient the chief indications are to slow the blood current, to quiet the nervous system and stimulate the secretions and excretions. By way of systemic treatment, this may be done by the use of tincture of aconite and veratrum viride, minim doses every half hour, and tincture of gelsemium, one-half-minim doses every hour till six minims have been given. Antikamnia, a proprietary mixture, which acts on all portions of the system in a quiet, soothing way, may be administered in five-grain tablets every half hour. Sulphide of calcium is generally a useful agent in this connection, in doses of grains 1-10—½. If the patient is suffering from constipation a laxative is indicated, a saline cathartic, and this, by the way, is as important a part of the systemic treatment as any. Instruct the patient to take a hot foot bath just before retiring, and if he is still suffering pain, and is especially nervous, there is nothing better than the action of

Dover's powder on retiring. If the patient is caused to perspire freely at night the result will be beneficial. In threatened formation of abscess, in which it is impossible to stop pus formation, this treatment will relieve the patient of much of the suffering.

In connection with severe cases of pyorrhea, ofttimes wise systemic treatment is beneficial as an aid to recovery of the local parts. Especially if the patient is suffering from constipation and anorexia, loss of functional activity and energy. And also there may be distinctly observed the odor of uric acid, urea in the blood, emanating from the system. Sometimes individuals with all these conditions will present for treatment. These individuals need a laxative; also something which will remove the uric acid from the blood. Wholesale nutrition is important. Proper, gentle, wholesome exercise in the fresh air is of the utmost importance. As a laxative in these cases there is nothing better than the following:

℞ Extract of cascara sagrada..........gr. ij
Extract of belladonna..............gr. 1-16
Extract of nux vomica.............gr. 1/8

put up in pill form by Parke, Davis & Co., and can be obtained at any drug store. These pills should be administered in such cases, at first, at least three times a day, and should be continued over a period of several weeks, at lesser intervals after the first week or so. There are several agents which may be used to do away with the uric acid in the blood. Piperozine, consisting of white crystals, is an excellent agent, although its taste is exceedingly bad. This should be administered in five-grain doses, dissolved in water and largely diluted, three times each day, a half hour before meals. There is a preparation of piperozine called lycetol, which is not so potent in its action, but which is much more pleasant to take. This should be given in doses of grains five to ten in a glass of water about half an hour before meals.

THIRTY-FIRST LECTURE.

Results of Experiments With, and Analysis of Various Medicinal Agents, Also of Various Solutions Used as Mouth Washes, Dentifrices, Etc.

(Copyrighted.)

BICHLORIDE OF MERCURY: One to one-thousand per cent solution; 33 drops are necessary for a c. c. Nine drops are necessary to prevent development of bacteria in the "unit of culture media," thus showing this solution effective as an antiseptic in 1 to 36 parts. Bichloride of mercury is in itself the most effective antiseptic of all these agents. It has in the past been used a great deal, especially in the treatment of abscesses with fistulous openings, and in antral troubles. But as we have proven conclusively, in using it about the soft parts, it is not so potent as many of the other agents, from the fact that albumin interferes with its potency; a sufficient amount of albumin being present renders it practically inert as an antiseptic. Nine drops of this solution prevent development of bacteria in the "unit of culture media," but if 10 per cent of albumin be added, the development of the germs is not restrained. The albumin destroys or antidotes the efficiency of the drug, so that you cannot depend wholly upon this agent in the treatment of troubles about the mouth where it comes in contact with more or less albumin.

ALCOHOL: Ninety-five per cent. Seventy-eight drops are necessary for a c. c. Eighty drops are required to prevent development of bacteria in the "unit of culture media," thus showing this agent effective as an antiseptic in 1 to 9 parts. No doubt the vast majority of you are familiar with the uses of alcohol, so that we need not refer to them.

IODOFORM: This agent is not an antiseptic. A saturated solution of it in the broth does not even restrain the development of germs. At first I could hardly believe it myself. I had always considered iodoform to be a good antiseptic. I made several tests before reconciling myself to the fact that it is not. I not only made a saturated solution of it in the broth, but added an excess of the powder, and the germs in each instance developed to the fullest extent, and seemed, in every way possible, very grateful for the flavor thus imparted to their food—the broth. However, the clinical fact remains that sores, under the treatment of iodoform, do exceedingly well. This is due to some peculiar property it possesses, to some peculiar sustaining influence it imparts to the newly forming granulation tissue.

NOSOPHENE: This is comparatively a recent production, and is placed on the market for the purpose of supplanting or replacing iodoform. It is recommended for the same purposes for which iodoform has been used. It is a whitish powder and is practically odorless, in this respect possessing a decided advantage over iodoform. Iodoform, to me, is one of the most offensive agents we have in the whole materia medica. Nosophene has been used a great deal, and the results from its use seem to be just as good as those from iodoform. From point of potency as an antiseptic, nosophene is no better than iodoform; the bacteria develop in the broth abundantly in the presence of a saturated solution of the agent, but because of the other desirable properties it possesses I feel that I am justified in recommending it to you to use in place of iodoform, except in cases where a deodorant is indicated, for no other odor can thrive in the presence of iodoform.

PEROXIDE OF HYDROGEN: Marchand's; 35 drops are necessary for a c. c. Six drops prevent development of bacteria in the "unit of culture media," showing that this agent is effective as an antiseptic in 1 to 58 parts. You all know what peroxide of hydrogen is used for, so I will not take time to say anything about that. It has long been known that peroxide of hydrogen contains more or less free acid; indeed, our standard medical works state that in the preparation of peroxide of hydrogen a certain amount of free acid is placed therein as a preservative. This acid has been supposed to be HCl, chiefly, and in some samples of peroxide there has been found as high as 5 per cent of HCl. Professor Hall and I have analyzed these agents and in connection with peroxide of hydrogen I can state the following: Specific gravity, 1.02; HCl in 100 c. c., .0454 grams (that is certainly a very low percentage as compared with what has been found in some preparations). Of sulphuric acid in 100 c. c. there was .381 grams. We were surprised to find sulphuric acid present in any degree. The total solids per 100

c. c., .0716 grams; amount of ash per 100 c. c., .236; soluble barium salts, none.

Where the use of peroxide of hydrogen is long continued in the treatment of pulpless teeth there is frequently a decided enlargement of the root-canals. This result has been ascribed very largely to the action of the mineral acids, but no doubt the oxidation by this agent is as important an element as is the action of the acids found in it.

PYROZONE: Thirty-five drops are necessary for a c. c. Six drops prevent development of bacteria in the "unit of culture media," thus showing this agent effective as an antiseptic in 1 to 58 parts. You are all familiar with the uses of pyrozone—very largely replacing in our work here that of peroxide of hydrogen. In connection with pyrozone I can state the following: 3 per cent pyrozone—specific gravity, 1.013; HCl, simply a trace; sulphuric acid per 100 c. c., .0302 grams. Total solids present in 100 c. c., .0716 grams; infusible ash, .0328 grams; soluble barium salts, none.

HYDROZONE: Thirty-five drops are necessary for 1 c. c. Six drops prevent development of bacteria in the "unit of culture media," thus showing this agent effective as an antiseptic in 1 to 58 parts. This agent is very much like the other two, and used for the same purposes. An analysis of hydrozone resulted as follows: Specific gravity, 1.034; HCl per 100 c. c., .0907 grams (about twice the quantity that there is in pyrozone and peroxide of hydrogen); sulphuric acid present in 100 c. c., 0.712 grams. Total solids per 100 c. c., .1648; infusible ash, .0648; soluble barium salts, none.

ANTISEPTIC SOLUTIONS USED AS MOUTH WASHES, DENTIFRICES, ETC.: I have not carried all these agents to their limit as antiseptics, but have experimented with them sufficiently to determine which ones are most potent as such. I have also, in conjunction with Professor Hall, tested them and analyzed them to determine whether they are acid in reaction, alkaline or neutral. Also to determine whether any of them contain mineral acids or anything else of like nature that would render them harmful to the delicate structures of the oral mucous membrane.

In the tests to determine their relative potency as antiseptics, I began by using five drops each of these agents in the culture tube, which latter contained 10 c. c. of bouillon.

As they failed to prevent the development of bacteria, each was gradually increased in amount until 20 drops were reached. Of Sanitol, this quantity, 20 drops, proved successful. No development of germs occurred in the tube. That the above result might be verified, a number of subsequent plants were made, in which I used a similar amount, and in no one of these did growth occur. As there are 76 drops of Sanitol in 1 c. c., this agent is antiseptic in 1 to 38 parts. By the analysis, from a chemical standpoint, Sanitol is shown to be neutral in reaction, and to contain no mineral acids or other ingredients that might prove harmful to the soft tissues.

I have had an application of this agent confined to the soft parts for thirty-six hours (the same as I have had all the others in this group), and found its therapeutic action to be that of a mild stimulant.

BOROLYPTOL: Next in potency as an antiseptic is Borolyptol. In the culture tube, in which 20 drops of this agent were used, just the slightest amount of development of bacteria was observed. At least a dozen subsequent tests of this agent were made, with no variation from the above result.

The chemical analysis of Borolyptol showed it to be acid in reaction; however, containing no mineral acids. Its contact with soft tissue for thirty-six hours showed it to be in this respect therapeutically a neutral agent; no evidence of stimulation being produced.

Twenty drops of Pasteurine restrained the development of bacteria in the culture tube, but not to the extent that Borolyptol did. Pasteurine is acid in reaction and contains a trace of sulphuric acid. It is non-stimulating to soft tissue.

Twenty drops of Wampole's solution restrained the development of bacteria in the "unit of culture media" to about the same extent as Pasteurine did. I have misplaced the chemical analysis of this agent, and at the present am unable to find it. It is non-stimulating to soft tissue.

Twenty drops of Glycothymoline failed to restrain the development of bacteria in the culture tube to any appreciable extent. This agent is strongly alkaline in reaction, and contains no mineral acids. It is non-stimulating to soft tissue.

There was full development of bacteria in the "unit of culture media" from the use of twenty drops each of Zymocide, which is strongly acid in reaction, but which contains no mineral acids; of Benzolyptus, which is slightly alkaline in reaction, and contains no mineral acids; of Euthymol, which is slightly acid in reaction, and contains no mineral acids; of Listerine, which is strongly acid in reaction and contains no mineral acids.

SOZODONT: Fifty gtts. of this agent produce no perceptible restraining effect on the development of bacteria in the "unit of culture media." It is alkaline in reaction.

THIRTY-SECOND LECTURE.

Tonics and Stimulants Used in Dentistry.

BY J. JAMES HOFFER.

Systemic medication in dentistry is considered by the average practitioner and student of dentistry to be of little value in treating diseases of the mouth.

A few, however, who are striving to advance the standing of the profession, are working on this line with extremely gratifying results, and it remains with these to bring the profession to be recognized as a specialized branch of medicine, as it really should be.

It is my intention not to call attention to all drugs that may be used to advantage in the systemic treatment of dental disorders, but to confine my remarks as nearly as possible to the use of tonics and stimulants, and not to treat so much of the drugs themselves as to the certain pathological conditions which indicate their use.

You have all learned, or should have, in your junior year, of the different drugs classed as tonics and stimulants, the dose of each, and more or less of the physiological action of these drugs upon the animal organism, but when it comes to the point of their use we are all up against it, if I may use the expression, we are a little timid about prescribing drugs for internal use, and the reason is that we have not familiarized ourselves with their use and the certain pathological conditions which indicate their use.

Let us consider for a minute what stimuli are. Potter says "stimulant is derived from the Latin stimulus (a goad); it is a term which is used in various senses, when applied to medicinal agents. Alcoholic preparations which are true narcotics are commonly termed stimulants, and the same expression is employed to designate any agent which excites even briefly the organic activity of any part of the system. All excessive stimulation reacts into depression, and most of the agents which stimulate the nerve centers at first will soon depress and finally paralyze them. In many cases the action is one of progressive stimulation primarily, and progressive paralysis afterward, affecting the centers in the inverse order of their development,

i. e., the highest and latest developed centers being affected first, and the lowest or oldest ones last."

We have diffusible stimulants, which have a prompt but transient effect on the general system, such as alcohol, ammonia, camphor, nitrate of amyl, etc.

Then there are spinal stimulants, such as strychnine, ergot, atropine, phosphorus, cardiac stimulants, respiratory, vasomotor and cerebral stimulants, renal stimulants or the diuretics, hepatic stimulants, which include chologogue purgatives, intestinal stimulants, viz.:

Mercurials, compound extract of colocynth; dose. gr. v-ix.
Compound powder of jalap; dose, gr. ii-x.
Extract of podophyllum; dose, gr. v-x.

Those which affect the glandular apparatus, such as belladonna, nux vomica, rhubarb, senna, alloes, etc., and those which affect the muscular fibers and intestinal nerves.

This will give you somewhat of an idea of the breadth of this field.

Now let us turn our attention to the physiological and pathological relation of the teeth to the general organism. This you will notice also has breadth and depth, and it will be impossible to traverse such a field with any degree of adequate thoroughness. I can only allude to a few of the more important conditions met with in the ordinary practice, in which systemic medication is advantageous. First let us consider the alveolar abscess, of which all of you are more or less familiar. We have here a condition which in a majority of cases will yield readily to local treatment if not too long delayed and if intelligently applied.

In some cases local treatment will relieve the symptoms, but there remain conditions in which local medication, unaided by active systemic treatment, will prove entirely inadequate to arrest the progress of the disease.

We all know the conditions that attend this kind of a case, and they are not trifling in character, at least to the patient, and there is probably no inflammation not involving a vital organ that is more painful or attended with graver constitutional disturbances. We all know the swollen condition of the tissues attended by *that* throbbing pain. The quickened pulse, the fever, the hypersensitiveness of the nervous system, arrested excretions and vitiated secretions. While these are mere transient departures, the prognosis will be necrosis, septicemia and a possibility of a fatal issue. These conditions should not be considered as trifling and every resource available to the healing art should be brought into use.

We will suppose you know the local treatment, and so will turn our attention directly to the systemic treatment.

There are two classes of remedies which are available in the systemic treatment of inflammatory conditions.

First, those remedies which, by acting through the nervous supply to the circulatory system, diminish the force and frequency of the pulse, and lessen the blood impact upon the inflamed area.

Secondly, those agents which, by stimulating the secretory and excretory organs, not only divert the blood from the inflamed area to the organs thus stimulated, but diminish the blood pressure by the drain established through the increased excretory outpour thus set up. To this class belong cathartics, emetics, diuretics and sudorifics.

The first class, the depressors of the vaso-motor system, belong aconite, and veratrum viride, etc.; they act, also, as stimulants to the gastro-intestinal, cutaneous and urinary secretions in a marked degree.

The use of opium, which is primarily a stimulant and ultimately a depressant to the circulatory system, and at the same time acts as a perspiratory stimulant, especially when combined with ipecacuanha, and aided by hot foot baths, or *hot toddies,* which is preferable to some, a marked diaphoresis is one of the most usual physiological effects.

The insensibility to pain produced by this drug also makes it a valuable agent in the treatment of all forms of inflammation.

Opium is constant in its action and in any reasonable medicinal dose is a perfectly safe remedy to employ.

This remedy is undoubtedly preferable to aconite or veratrum, as both are powerful cardiac poisons and are not uniform in their action, often producing toxic symptoms, even when given in small doses.

If these drugs, i. e., aconite and veratrum, are used, the patient should be carefully watched through the entire course of their administration. This is not necessary in opium, and in nearly all pathological conditions in which acute inflammation is present, or to follow, it is indicated.

It is used a great deal as abortive treatment of abscesses, and when it fails in this, with the use of an occasional saline cathartic to avoid the constipating tendencies, the patient should be kept well under the influence of this drug throughout the entire evolution of the suppurative process. By this treatment the inflammation will be lessened in its extent and the pain reduced to a minimum.

Quinine may be also used to good advantage, and while not possessing the active properties of opium, it is at least a valuable ally in the treatment of inflammatory conditions, and in peridental inflammation it may be freely administered in the ordinary medicinal dose, with decided advantage.

In the treatment of this infected condition, as it were, it is necessary that we deal with micro-organisms and their waste products. We have learned from Prof. Black, that, in case from any pathological condition the elimination of urea is prohibited (urea, as you know, is one of the waste products produced by the animal organism), we have a case of uremic poisoning, and there is a probability of a fatal issue if allowed to continue.

One of the necessities of life is the production of waste products, and the micro-organisms which are living plants, must produce these products. Certain of these are poisonous to the animal organism and affect certain parts of said organism; for instance, some of the toxins developed by these micro-organisms affect certain nervous centers and increase the bodily temperature above the normal.

In the natural sequence of events these products will be eliminated, but if their elimination is long delayed the effect will be deleterious. They are eliminated chiefly by the kidneys, so you can readily see the advisability of giving renal stimulants or diuretics, such as turpentine gr. v-xx, compound spirit of juniper. It approximates a good quality of gin very closely and depends largely on its alcohol for its action. The dose is from ʒ i-iv.

The effervescent citrate of caffeine is very agreeable to take, as when given in ʒ i doses in a glass of water, it makes a very pleasant drink.

I see that I have practically omitted the discussion of tonics so far, and we will now direct our attention to that line of thought.

Disuse of the teeth by some patients and the improper mastication of food due to diseased teeth is often a very potent cause of gastric troubles, and these are related very closely to our line of work.

In patients of this sort we usually find the system is undermined and broken down and the patient in a weakened nervous condition, and in no shape to undergo any lengthy or severe dental operation. The effect of sedatives on a patient is but transient, and we must relieve the patient by temporary local treatment, and then turn our attention to the systemic use of tonics, accompanied with the proper dietary.

The use of gastric tonics is here indicated. Potter says: "These include a number of substances, dietetic and medicinal, some acting by stimulating the production of gastric juice, others by stimulating the local circulation, and some by exciting of the nervo-muscular apparatus of the stomach.

The first indication is met with in the dilute alkaline solutions before meals. The second by pungent carminatives as the essential oils, capsicum, etc., and alcohol and ether in small doses, and aromatic or simple bitters, while the third desideratum is secured by the use of such agents as nux (m. v-xx of tinct.) fluid ext. hydrastis (m. v-xxx), and the use of Fowler's Solution of bs. is very good, starting with m. ii, t. t. d. after meals and increasing one drop daily until ten are given. Continue this until there is an itching of the eyelids and then decrease the dose. This will be found to be an excellent tonic, both gastric and general.

In many cases of neuralgia it is very beneficial and often gives prompt and permanent relief.

The dilute mineral acids, especially HCl, or its use, if given before meals, decreases the acidity of the stomach. It promotes the alkaline secretions of the intestines.

Their use should not be continued for any length of time, as they will impair the digestion by decreasing the production of the acid gastric juice.

The treatment of neuralgia, especially that of the fifth pair of cranial nerves, is of great import to the dentist. The drugs that may be used in the treatment of this pathological condition is almost of unlimited supply, but we will consider a few of them.

Opium internally and morph. sulph. 1-16—¼ hypodermically, are most effective, as they afford relief in a very short time and often effect a cure.

Arsenic I have spoken of before. It cures by its influence on bodily nutrition.

"Bromide of gold and arsenic rendered good service in a case of trifacial neuralgia, diagnosed as due to syphilis, after other treatment besides the anti-syphilitic had failed." (Wood.)

Strychnine in small doses, 1-100—1-60, is good.

Quinine in large doses gr. v-xx, in wine, just before an attack in periodical neuralgia, and is also useful in small, repeated doses in other types, especially trifacial neuralgia.

Amyl nitrate, if inhaled, is often beneficial in relieving neuralgia of the fifth gelseminum, m. ii-x.

Most any authority will give you the necessary information in regard to the use of these drugs in neuralgia, and it would be well for all of us to post ourselves pretty thoroughly on this subject, as it is extremely important to dentists.

I feel that I have not covered the ground in nearly the thorough manner which I should have liked, but my time is limited and my clinical experience is my greatest limitation. I hope, however, that there will come a time when I can produce a paper that will contain more logic at least, and be based on my own clinical experience.

We must work along the lines of general pathology, materia medica and theraputics, and the more we become acquainted with these general subjects the better able we will be to appreciate the relation of our special science to that of general medicine.

We must remember that any science or art that is not advancing is retrograding. Dentistry cannot stand still. We must search for the cause as well as the cure, strive to prevent as well as to remedy disease. We must not limit ourselves. Don't be afraid that you are running into the general practitioner's field. Did they ever let it worry them about keeping out of ours?

Most physicians would let a patient die before summoning the aid of a dentist, if there was a possibility of the dentist being more able to cope with the disorder at hand. There are physicians right now who still put poultices on the face in the treatment of alveolar abscesses, and then they lance it on the outside of the face and put on iodoform and think they are doing the right thing, or else they don't think.

I have strayed somewhat from my subject, but I hope you will pardon my little roast to medics, but I always have my hammer out for the kind of men who do not give us credit with knowing anything but a trade.

We must not confine ourselves to the pathology of the oral cavity, but the entire digestive tract as well, in so far at least as it is concerned in the perversion of nutrition, which are associated with and causative of, dental and oral diseases.

Upon this field of investigation, so great in interest, so vast in importance, so far-reaching in its possibilities, dentistry can most fittingly enter, and when the large body of intelligent, scientific workers now found in its ranks are once systematically directed to the careful study of the vital processes connected with nutrition and its aberrations, the result cannot be otherwise than broadening to ourselves and helpful to science and our art.

Discussion by E. A. Werner:

Mr. Hoffer has so thoroughly covered the subject that a discussion is quite out of the question. An opportunity to read his paper did not present itself, so what I have to say is only a repetition of his statements. Had I, however, read the paper, I should have made every effort to avoid repetition, and endeavored to say something not included in his paper just read.

As to stimulants: The two divisions or classes which concern us most as dentists (?), are, in my opinion, cardiac stimulants and respiratory stimulants. There are however, twelve classes, as follows: Diffusible stimulants, spinal stimulants, cardiac stimulants, respiratory stimulants, vaso-motor stimulants, cerebral stimulants, renal stimulants, hepatic stimulants, intestinal stimulants, cutaneous stimulants, stomachic stimulants and local stimulants.

The drugs which are mostly used in the practice of medicine are ammonia, caffeine, atropine, cocaine and strychnine; of these the latter is probably the most certain and constant in its action. Its dose I need not state, being known by all present.

Depressants are closely related to stimulants. Dr. Wood states that "any drug which is a motor stimulant or motor depressant is correspondingly a respiratory depressant or a respiratory stimulant, because the respiratory centers share the action of the drug upon the whole motor tract of the cord. This statement of Dr. Wood's leaves no room for discussion, as far as depressants are concerned, in the subject before us.

A cardiac stimulant is any medicine which, given internally, increases the power and force of the circulation. I mention a few such agents, which are always easily obtainable when needed and familiar to all. They are ammonia and alcohol. Internally, the chief indication for the use of ammonia is failure of the heart's action. Ammonia acts directly upon the circulation.

Alcohol, which is a promoter of animal heat, increases the frequency and force of the pulse. The cases to which it is especially adapted are:

"First, where there is a loss of heart power, as in fainting, from loss of blood, etc.

"Second, in acute diseases, where the powers of the system are in danger of being used up, as in the common disease, typhoid fever.

"Third, in diseases where there is a depressing agent, as in cases of poisoning from snake bite, etc."

When alcohol is administered it should be given hot, and usually with some other more diffusible stimulant, such as ammonia.

Tonics are included in our discussion, but I will only speak of them briefly. By a tonic we mean "an agent which improves the tone of the tissues, on which they have specific action."

Tonics are divided into three classes, i. e., cardiac, vascular and gastric.

Iron is beyond doubt foremost as a tonic, yet nitric acid, hydrochloric acid and sulphuric acid are most excellent tonics when given in therapeutic doses. They should be well diluted.

The dose for sulphuric acid is from 10 to 20 drops. When taken internally in therapeutic doses it is converted into sulphates and thus eliminated.

The dose for nitric acid is from 15 to 60 drops.

The following table gives medicines which may be administered, when indicated, as tonics. This has been prepared hurriedly, yet will answer our purpose this morning:

For gastric tonics: Bismuth, arsenic, cinchona and nux vomica.

Heart tonics: Digitalis and squills.

Nerve tonics: Phophorus and quinine.

Muscular tonics: Tannin.

Blood tonics: Iron and manganese.

The doses for each drug mentioned are familiar to all, so will not give them, as our time is limited. I thank Dr. Peck and the class for sharing in this discussion, the last of our college course.

Discussion by S. C. Kramer:

I wish to compliment Mr. Hoffer on his paper; he gave it to me two days ago, and on reading it over I decided not to discuss the paper itself, but to speak briefly about the treatment of some of the severe cases of neuralgia.

Cataphoresis is sometimes used where nothing else seems to give relief. Dr. Morton of New York reports case of one and a half years' standing, patient suffering usual agonizing pains every few minutes.

A 10 per cent solution of cocaine was used, placing it in a sponge over the affected part, and the patient holding sponge and wire cathode in hand. The current was increased from nine Genet cells up to twelve cells and held at the latter for five minutes, the whole application taking about ten minutes. There was the expected anesthesia and patient was free from pain for eleven hours, the longest period since she had been afflicted with the disease.

Some of the older and also later writers say that the use of narcotics or anodynes, and especially opium, which is probably the best, should be given in full doses. An adult taking 2 grains of opium, or from 30 to 60 min. of laudanum.

General neuralgia is a disease of debility and is found in the cold, pale and feeble, or persons of evidently broken health. In such cases the tonic medicines offer most advantages, and of these the salts of iron are probably the best.

Discussion by L. G. Hotch:

Opium.

Probably there is no drug that has so wide a range as this one, while at the same time it requires very careful handling. Children are very susceptible to its narcotic action, while women are more easily affected than men. It is contra-indicated or used with great care in alcoholism. Its action you are all familiar with.

Treatment is to evacuate stomach, maintain respiration and keep up circulation.

Gelsemium.

This drug is a product of the roots of a climbing plant, the yellow jasmine. It contains an alkaloid in combination with an acid; also volatile oil and a resin. Its action is of a powerful motor depressant, causing depression of sensibility by action on spinal cord. In moderate doses it causes languor, slowing of cardiac rate, feebleness of muscular action, drooping eyelids. Toxic doses produce feeble heart, vertigo, labored breathing, loss of articulation, death by asphyxia. Gelsemium, though it lowers the heart rate, is not an arterial depressant and does not irritate the gastro-intestinal tract. Moderate doses pass off in about three hours. It produces a decided lowering of body temperature. This drug is contra-indicated in individuals who have weak hearts, but used in fevers, many forms of sleeplessness, pneumonia and plenarsia.

Dr. Gilmer recommends it very highly for neuralgia, as it has great affinity for the fifth nerves. Should be given at intervals of about four hours, 5 to 8 drops at a time. Should the patient have double vision it should not be repeated. The antagonist for gelsemium, morphine, is most complete, but digitalis, ammonia and alcohol are also good.

Discussion by A. R. Kempter:

While Mr. Hoffer has discussed the theoretical part of tonics and stimulants, it is my intention to make a few remarks concerning their practical use. By this I mean their use in conditions that are liable to occur at any time, that are liable to occur when least expected, and which we should be familiar with and ready to meet at any time. I refer to such conditions as shock, fainting, cocaine poisoning and poisoning with arsenic—cases in which we should be able to think and act promptly and properly, and, above all, know just what stimulant or tonic we are going to use, and how to use it. I don't intend to say which one is best for each particular purpose, but only wish to suggest that whichever we use we should have in readiness and know how to use it.